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THE FOUNDRY

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Trade Outlook.

There are evidences of slackening in the pace of foundry operations in several lines, though it cannot be said that the change is anything pronounced thus far. It has been thought that the restricted buying of pig iron by foundrymen has been due entirely to the expectation of lower prices; but there also appears now the factor of slightly diminished demand for castings.

Labor troubles in foundries are less in some sections, while elsewhere fresh disputes are added to the list. Foundrymen, in recent conferences over labor demands, have asserted that the outlook is not so good from their standpoint as it was one year ago. In St. Louis the new wage settlement which went into effect July 1 provides that the rate of wages shall come up again for adjustment October 15, the foundrymen taking the position that the developments meantime will show that the advance made should not continue through the scale year. At Pittsburg the molders voted not to accept the compromise offered by the foundrymen, but there is still an expectation that a settlement will be made without a strike. The foundries which make rolling mill castings are beginning to feel the effect of the falling off in new construction of iron and steel works, and the indications are that the campaign of new erection in this line that has contributed so much to the prosperity of heavy work foundries in the past three or four years, is practically over for the present, apart from the work the United States Steel Corporation is putting through.

Since our last review the associated Southern furnaces held a meeting in Chicago, and reduced their price on No. 2 foundry iron to $13.50, Birmingham, or $1.50 less than before. This has had no effect on the market, as independent furnaces were selling at $13 at the time. Buyers still hold off on placing contracts, though there has been more inquiry and more business in the way of small-lot purchases in the past 10 days than in the like period just preceding. Some of these purchases are made by buyers who are refusing to take iron on old contracts on the ground that the furnaces sold spot iron at good prices some months ago instead of making full deliveries on contracts.

In the Chicago district inquiry from foundries represents a large total, but consumers intimate that $12 Birmingham is their maximum. Northern furnaces are quoting lower on foundry iron, $15.60 for No. 2 at Ohio River furnace being reported, and a sale of 1,000 tons of No. 2 at $17.85 delivered at Pittsburg. The large harvester company purchase, pending in the Chicago district, is still open, though rumors of a sale, with prices, have been abroad. In the South a number of furnaces which buy their coke in the open market banked in the third week in July, in consequence of the coal miners' strike. On July 21, however, an agreement was reached at Birmingham on a plan of arbitration. The miners refused a judge of the United States court for fifth arbitrator and it was decided that the latter be chosen by the four representing the contending parties. Work was resumed pending the investigation by the arbitrators.

Henry Hansen Is Dead.

Nothing could be written or said that could have modified the acuteness of the shock the sad news from Mt. Clemens on July 8 gave his associates in Cleveland and which later was borne by the Associated Press throughout the land:

"Henry Hansen is dead."

His was a peculiar personality—not one that could be adequately defined or comprehensively explained. He was Hansen—just Hansen—original—rugged — honest—fun-loving—sincere — persevering; a man of strong convictions, and he was a worker.

No one ever thought of him in just the way one would of the average or the ordinary man in any walk of life. He was distant, yet exceedingly approachable; generously frank and outspoken at times, yet by nature reserved. If these and other characteristics of an unusual mind appear contradictory, it must be remembered that Hansen was a living paradox.

He never wrote, spoke, thought or acted in just the way other men did. He was unconventional to an extreme, without being ostentatiously so, and all he did reflected a marked mentality that had its own particular charm.

We all liked him; every one who knew him liked him, and what is more, admired and respected him.

He was only thirty-eight years of age, but they had been active, busy years, full of hardship, struggle and adventure. He was born in Denmark in 1865; came to America when only a boy and came alone, leaving parents behind.

There were few foundry centers between the Atlantic and Pacific which he did not visit in the next ten years, after he had learned the molder's trade; to say nothing of a cruise made as a sailor from a Pacific port.

When THE FOUNDRY appeared first in 1892, he was one of its earliest contributors and a few years later became its associate editor, remaining in that capacity until his death, with the exception of a brief period during which he had charge of a foundry at Northville, Mich.

But think of the transformation from the humble Danish emigrant boy, seeking his fortune without friends or means in a new land, or the molder's apprentice laboring under numberless disadvantages among strangers, to an editorial position.

But he did it and he did other things not generally known. Not only did he acquire sufficient of the language of the New World to write it with a style peculiarly attractive, but Henry Hansen found the leisure moments to master the details of several scientific branches of learning and to acquire a mathematical education that many a college graduate might envy.

But he never told any one what he was doing; only those who knew him wondered always why he had to work so much at night,

until the truth by accident leaked out, and we have the authority of his preceptors that his record was a phenomenal one.

That is the way Hansen did things and it is recorded here only for purposes of illustration.

Those who knew him but superficially were attracted by his sense of humor and his original methods of expression. No letter was complete that lacked some evidence of this very unique attribute, as hundreds can testify.

But it was for his journalistic work that he will be best remembered. Who ever read "Pokey's Pointers" without appreciating the keen wit and thorough familiarity with foundry conditions possessed by the author; and the homely truths so forcibly preached by "Pokey" will be long remembered.

Later, the "Kranks' Korner" gave its author opportunity to enlarge occasionally upon some absurdity connected with the business and to do it with a piquancy that made a lasting impression.

It was the same with all he did; and his work, his office records and systems were characterized by a Scandinavian thoroughness rarely seen.

But it is all over—Hansen is gone. This issue contains the last line he ever wrote. His final manuscript, uncompleted and reproduced in another column, apparently written when he was bowed with suffering and weakness, his body racked with pain and his erstwhile rugged, robust physique wasted away, will always be prized by its owner, the writer of these few lines, who knew him well and who with difficulty persuaded him to leave the sand heap and accept a position with greater opportunities.

THE FOUNDRY was a success from the beginning, but it owes much to him who has gone so suddenly on before, and who stamped the imprint of his remarkable individuality upon its pages.

He came to us unknown; he did his best; we were proud of him; we are proud of him now. And while extending to his bereaved wife and two children all possible sympathy, we feel that in this hour of sorrow there are thousands who will feel with us a sense of personal loss and who will long remember that kindly, honest, brilliant intellect that they knew personally or through our columns.

Henry Hansen is dead.

A Cast Iron Session of Testing Engineers.

Of no little importance in the movement that is destined to give cast iron the place it should take in the engineering world, is the work of the cast iron committee of the American Society for Testing Materials. The annual meeting of this society was held at Delaware Water Gap, Pa., July 1, 2 and 3, and there were present a number of gentlemen who have done good work toward establishing methods and standards for testing cast iron. The meeting was attended by over 100 members and visitors, of whom a score or more are particularly interested in cast iron.

The first report presented relating to cast iron was by Walter Wood, of R. D. Wood & Co., Philadelphia, chairman of the committee on Standard specifications for cast iron and finished castings. In April, the report showed, the following sub-committees were appointed with the chairmen named:

Pig iron—Edgar S. Cook, Warwick Iron & Steel Co., Pottstown, Pa. Pipe—Walter Wood, R. D. Wood & Co., Philadelphia. Cylinders—H. V. Wille, Baldwin Locomotive Works, Philadelphia. Car wheels—Dr. Chas. B. Dudley, Pennsylvania Railroad, Altoona, Pa. Malleable cast iron—Stanley G. Flagg, Jr., Philadelphia. General castings—Thos. D. West, Sharpsville, Pa. Testing cast iron—Henry Souther, Hartford, Conn. Influence of special metals on cast iron—A. L. Colby, South Bethlehem, Pa. Structure of cast iron—Prof. A. Sauveur, Cambridge, Mass.

Reports of progress by these sub-committees were incorporated in Chairman Wood's report. The sub-committee on cast iron pipe presented the specifications thus far formulated by the manufacturers and water works engineers. Henry Souther, in laying out the work of his sub-committee, had sent letters of inquiry which had brought out quite a diversity of replies. The transverse test was emphasized as all-important and more reliable in cast iron than the tensile test. Special lines of manufacture, it was pointed out in the letters, call for special test bars and there are trade customs that it will be difficult to alter, but a standard test bar for general reference, in other words an "arbitration bar," was thought entirely practicable.

STANDARD FOR GENERAL CASTINGS.

Thos. D. West, of the sub-committee on general castings, submitted the following:

"There are several points which require careful consideration before any action is taken to establish a standard. First: What is the character of work that should be considered as general castings? Second: What special character of specifications should govern each separate class of general castings. Third: Whether the test bar cannot be made the fundamental guide for obtaining the desired physical qualities of many classes of general castings.

"In commenting upon the first, I would suggest the following gray and chilled iron specialties, classified in the order shown. 1. Stoves and household heating furnaces. 2. Hollow ware and bath tubs. 3. Radiators. 4. Small pipe fittings and valves. 5. Pulleys and flywheels. 6. Dynamos and electrical work. 7. Hydraulic cylinders. 8. Pneumatic cylinders. 9. Freezing machinery. 10. Gas engines. 11. Steam cylinders and pumps. 12. Ingot molds. 13. Annealing pots and pans and gas retorts. 14. Acid proof castings. 15. Cast and cut gearing. 16. Punch, chear, stamping and crushing presses. 17. Lathes, planers, shapers, and drill presses. 18. Printing presses. 19. Wood working machinery. 20. Weaving machinery. 21. Sewing machines. 22. Agricultural machinery. 23. Fan and blowers. 24. Foundry molding machines. 25. Journal boxes and hangers. 26. Sidewalk grating and manholes. 27. Furnace and floor plate castings. 28. Grate bars and fire backs. 29. Column and architectural castings. 30. Air brake and railroad castings. 31. Brake shoes—chilled and gray. 32. Squeezer plates and rolls, chilled and gray. 33. Rolls, chilled and sand. 34. Miscellaneous rough and machined castings.

"In the above specialties are lines of gray and chilled iron castings which have taken many years' labor and experience to perfect to meet the demands of modern service. The qualities exacted are best known to the makers and users. I do not wish it thought that I believe all the specialties shown are possible of being standardized; however, it is felt that dealers and users would gladly welcome any standard tests that would enable them to judge fairly of the durability of the new casting which they were purchasing. With this view of the subject it would seem that efforts should be put forth to formulate standards for testing all the lines of castings mentioned, as far as this is practical.

"In discussing the second proposition we are called upon to suggest special methods to govern tests for the various specialties cited. In standards for testing stoves, etc., or Nos. 1, 2 and 3, it would be well where they are of a nature that would test the ability of independent duplicate parts to withstand radical changes in temperature or expansion and contraction under impact tests, in connection with the use of a proper size and form of test bars, to give the contraction and strength of the iron comprising the heat of castings being tested.

No. 4 would be well tested by having some stated standard of form and size to undergo tests of actual practice.

"No. 5 could probably not be better standardized than by tests showing the contraction and strength of the iron in connection with chemical analysis.

"No. 6 involves physical qualities which could be well displayed for the work intended by hardness tests and chemical analysis.

"Nos. 7, 8, 9 are best tested by hydraulic pressure and are a class of work where standardizing would call for very varied practices. The test bar and chemical analysis might assist for many cases, but the hydraulic test which would disclose the evils of shrinkage should stand paramount to all others.

"Nos. 10 and 11 could be standardized by testing the constraction, strength and hardness of the iron comprising their structure.

"Nos. 12, 13 and 14 are best standardized by chemical analysis.

"Nos. 15 to 34 will be best judged of by means of standard test bars and chemical analysis.

"The third proposition advances the use of test bars in assisting to standardize general castings. I believe at the meeting of April 25 this was not the intent of those present. I fail to perceive how many general castings can be standardized without their use, and for this reason I advocate their adoption as shown. It must be evident that to formulate standards for testing many of the specialties shown, involves great amount of labor and much expense, in some cases, as an example, as much as did the standardizing of tests for car wheels. For this reason an early formulation of standards cannot be expected."

GRADING FOUNDRY IRON BY ANALYSIS.

The pig iron sub-committee held a session on the second day of the convention and in-

vited members interested to participate in the discussions. The chairman of the sub-committee, Edgar S. Cook, of the Warwick Iron and Steel Co., Pottstown, Pa., presided, and N. B. Wittman, of Potts & Wittman, Philadelphia, acted as secretary.

A report was presented of a meeting of the sub-committee held at Philadelphia, June 2, at which it was decided to recommend that all buying of pig iron hereafter be on analysis, rather than on fracture or appearance. The following were recommended as analyses of the various grades named, and to be followed where no analysis was specified. Other elements, apart from silicon and sulphur, depending on the brand of the iron, cannot be generalized:

	Silicon.	Sulphur.
American Scotch.....	Above 3.00	.03
No. 1.....	2.50 to 3.00	.03
No. 2X.....	2.00 to 2.50	.045
No. 2.....	1.75 to 2.25	.055
No. 3.....	1.50 and over	.075

Mr. Cook, the chairman, urged the necessity of some agreement on the basis of grading and on the allowable variation. He had known iron to be refused by a foundry because it was .1 per cent above or below the specified silicon—this on a falling market. He thought no furnaceman would guarantee that his analysis would come within 0.25 per cent in silicon of the analysis of the foundry's chemist. Some allowance should be agreed upon to cover differences in sampling, personal equation, etc.

A resolution by Albert Ladd Colby was adopted as follows, with a view to securing uniformity in sampling:

"In contracts in which pig iron is sold on chemical analysis, it is the opinion of this association that each carload, or its equivalent, be considered as a unit, and that in said carload each two tons of iron shall be represented by a pig, said pigs to be selected at random, so as to fairly represent the carload of iron. Furthermore, that the drillings be taken so as to fairly represent the surface of each pig; and that the sample enalyzed consist of an equal quantity of drillings from each pig, well mixed and ground before analysis."

There was a long discussion on the grading scheme presented by the sub-committee. Mr. W. G. Scott, who prepared the J. I. Case Threshing Machine Co. specifications, said that .05 was the highest allowable sulphur in the pig iron bought by that company. This, with the sulphur taken up from the coke in the cupola, gave as high sulphur as could be tolerated in the casting.

Mr. Cook remarked that foundrymen could regulate sulphur in the cupola if they paid as much attention to it as to some other things.

The secretary referred to some correspondence which preceded the Philadelphia meeting of June 2. F. A. Flather, of the McCormick division of the International Harvester Co., wrote quite in accord with the proposal to do away with fractures as an indication of grade. He thought too much latitude was allowed on sulphur in the proposed scheme. In the case of No. 2 he suggested silicon, 1.75 to 2.25 and sulphur, 0.05 maximum, and of No. 3, 1.50 and over of silicon and 0.055 sulphur maximum. Mr. Flather brought up the question of a reduction in price for off-grade iron. For instance, a No. 2 X iron is found to have as high as 0.065 sulphur. Suppose the commonly accepted reduction is $1 per unit for sulphur, this iron should then be settled for at a reduction in price of $2 per ton. A similar reduction should exist for variation in silicon. If such an arrangement or reduced prices could be placed upon an equitable basis, the many off grades would in this manner be taken care of without further subdivision of grades as already given. Such irons would in this manner be properly classified and at the same time their value definitely set.

After prolonged discussion the committee passed the following resolution:

"In all contracts, in the absence of a definite understanding to the contrary, a variation of 10 per cent of silicon either way, and of 0.01 per cent of sulphur above the standard is allowed. A deficiency of over 10 per cent in the silicon up to 20 per cent and a further increase in sulphur up to 0.01 per cent over the above allowance subjects the shipment to a penalty of 1 per cent in the price for each element so affected.

As finally changed, the recommendation of the sub-committee as to the silicon and sulphur of standard grades, in the absence of specifications, was as follows, this to become the base of the above allowances and penalties.

Grade.	Silicon per cent.	Sulphur per cent.
No. 1 Foundry.....	2.75	.035
No. 2 Foundry.....	2.25	.045
No. 3 Foundry.....	1.75	.055
No. 4 Foundry.....	1.25	.065

The above scheme is promulgated to the

trade for adoption as a basis of settlement between buyer and seller, where errors arise due to differences in methods of sampling or analysis or to the personal equation in sampling and analyzing.

VARIOUS CAST IRON TOPICS.

On the last day of the meeting the morning session was given to cast iron. E. S. Cook read a paper on "Machine-cast Sandless Pig Iron," which gave the result of recent experience with foundry iron cast in molds and free from sand, and supplemented a paper read by Mr. Cook before the Foundrymen's Association at Philadelphia in May, 1899. Mr. Cook in his later paper says that with but few exceptions machine-cast sandless foundry pig iron has met with unqualified approval. "The advantages of sandless iron accrue chiefly to the foundry. The benefit to the furnace is found solely in relieving the management from the labor troubles incident to securing men to break hot iron in the pig beds, and remove from beds in the limited time necessary. As an economical proposition, our experience of a year or more would show that there is no saving of expense, but rather the reverse. The cost of labor and of maintenance of the casting machine is in excess of the human machine. In addition, the yield of ore mixture in iron is less, when the shipments are of sandless iron, as compared with sand casting, thus showing that notwithstanding the usual allowance for sand the customer receives more pounds of iron per ton of sandless pig than of sand cast. This fact, together with greater ease of melting in cupola (the sand covering being more infusible than iron) and the greater uniformity of casting machine sandless iron, will explain why it has met with such general favor."

There was some discussion of the paper by C. H. Vannier, of the Griffin Car Wheel Co., Chicago, and W. G. Scott, who desired information on the average quantity of sand on sand-cast pig iron as it left the blast furnace. Mr. Cook stated that this had never been determined with any degree of accuracy, but that as a rule much less sand was shipped than is allowed to the founder, so that he has the advantage in the sand allowance given by the blast furnaces. As to the amount of slag and the fusibility of the sand on the pigs as experienced by the foundries, this depended upon sand into which the pigs were cast. A purely silicious sand left a skin that was so infusible that it often remained intact after the iron had run out, even coming down that way when the bottom is dropped. A sand full of lime and clay, on the other hand, melted and slagged off readily in the cupola. Mr. Cook said, in answer to a question, that in time one could learn to judge sandless iron by its appearance—not in fine limits, perhaps, but neither was this possible in the case of the fracture of sand cast pig.

Other papers read at this session, some of them by title, were the following: "The Physical Properties of Malleable Castings, as Influenced by the Process of Manufacture," by Richard Moldenke; "Cast Iron for Dynamo and Motor Frames," by H. E. Diller, Western Electric Co., Chicago,; "Consideration of the Reactions which Make Cast Iron Valuable," by H. E. Field, Farrel Foundry and Machine Co., Ansonia, Conn.; "The Importance of Adopting Standard Sizes of Test Bars for Determining the Strength of Cast Iron," by A. E. Outerbridge, Jr., of Philadelphia; "The Demand for a Specified Grade of Pig Iron," by W. G. Scott, Racine, Wis.

In the general discussion on test bars which followed, Mr. Scott said that it was useless to ask all the interested parties to agree upon a standard method of making shop tests of cast iron, as each man had his own ideas on the subject, and could not well be asked to throw away the experience of years along his lines to adopt a new method. However, the proposition of Mr. Wood to adopt a so-called "arbitration bar" which would serve all purposes of domestic and international trade was something which he heartily advocated. Dr. Moldenke next explained the work of the American Foundrymen's Association on these lines, and how it strove to obtain facts which would allow the preparation of bars as free from external varying influences as could be made. How the 1½ inch diameter bar cast on end was best suited for the softer irons, and larger bars for the harder irons, the idea being to get bars as large as expedient to get results which could not be called artificially strong. He was satisfied, however, that the arbitration bar was something badly needed, and felt that if the 1½-inch round bar, slightly turned off to remove surface cracks, cast on end to prevent the variation of strength between top and bottom of the bars cast flat, such a bar would be in line for general adoption as a standard. Inasmuch as it was fair and not

being used except for trade contracts and in disputes, special pains could be taken to have it made just right. He heartily endorsed this stand, which seemed to meet with general approval, and certainly was a long step ahead in the right direction, and in no way interfered with individual liberty of action in the shop for the daily work.

Molding Machines.*

BY EDWARD B. GILMOUR.

The introduction of the molding machine into the foundry has been the cause of many a heated argument. Articles have been written and discussed from many points of view; also from the standpoint of the incessant demand for increased production of certain articles, thus necessarily compelling the foundrymen to wake up and follow the demand.

The molder originally refused to work upon these machines, or at least refused to put up the amount of work necessary to pay for the investment, simply on account of the fact that he became a mere automaton. The mechanic who worked these machines was a mere pounder of sand, and consequently, in order to bring them into successful use, the manufacturer was compelled to employ unskilled labor. The molding machine in one form or another has been in the foundry for many years, but only recently has it received the attention which it deserves, and that simply because the progressive foundryman is devising the most effective and economical methods to produce the best results, and at the same time obtain as near as possible perfect castings.

One of the greatest advantages to be attained in a successful foundry is the ability to carry on the work in the least possible amount of space, more especially in prosperous times, when floor space is at a premium, all foundries being then too small for their requirements. Here is where the molding machine comes in.

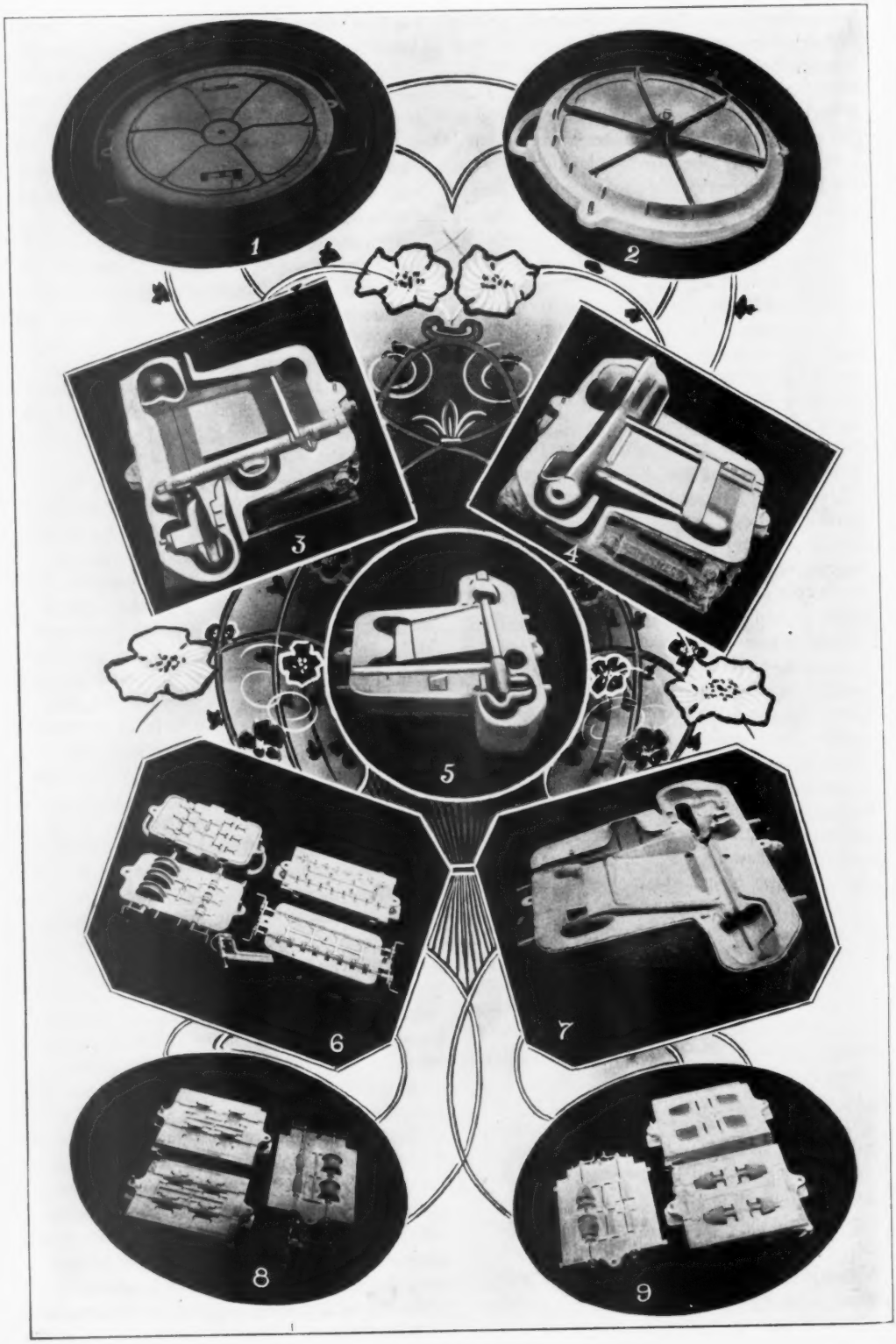
In the first place plate molding was resorted to on account of the accuracy of the castings made thereby, the patterns not receiving the rapping, shaking, and twisting, so common in hand molding, in order to get them out of the sand, and as a natural consequence the castings were more perfect and in many cases could be used in the rough state without any machine work having to be done on them. Afterwards the more improved method of the stripping plate was introduced, which is giving very satisfactory results. The great aim of the manufacturer of molding machines is to do away with the ramming of the sand. In a great many cases he has been very successful, but as a rule only upon what may be termed flat backs.

The great trouble with the "squeezer" is that it makes the outer surface of the mold so hard that it is difficult for the gases to find an easy exit through the sand. In order to obviate this trouble, a loose frame the size of the flask about one inch and a half thick is placed over the top of the flask so that when the mold is squeezed this frame is removed and the hard surface of the sand scraped off in line with the flask. Another difficulty in employing squeezing machines is that there is a large amount of sand right about the operator's feet. In order to get rid of the sand the conveyor was designed so that the sand as it is required would simply drop down upon the flask. This again has not proved as successful as might have been expected, because in many instances just as much work is accomplished by the use of the shovel, thereby saving the very expensive conveyors and shortening the great distance necessary to carry the flasks from the machine to their place on the molding floor. The same principle holds good in this case as it does in the old style of "snap benches" which are fastened to the wall as against the new style which are movable, so that they can be moved about as the sand is used up.

The method of making stripping plate machines is very simple, and in many cases almost as cheap as would be the regular gate of patterns with match board. This will be seen from the attached illustrations. A flat plate is cast having a hole cut the shape of the pattern, with about ¾ of an inch clearance around the pattern. Slots or nails are put in the edges of the plates to hold the soft metal, a very good composition for which is 8 parts of tin, 4 of lead, and one of bismuth. This metal is very fusible and is poured around the pattern into the clearance space. The pattern is then taken away and the lower edge is beveled to reduce the friction in dropping the pattern when the mold is made.

Fig. 3 is the drag part of a complicated stripping plate drop pattern machine for mold-

*Paper read at the Milwaukee meeting of the A. F. A.



MOLDING MACHINES.

ing mower frames, the first cost of this machine is great, but when you consider the difference in cost of the castings, it would be cheap at double the price, as the reduction in cost in this instance is over 75 per cent.

Fig. 5 is a mold made from this machine with all the cores set in position. Fig. 4 is the machine to make the core part for this mold. It is exactly the opposite shape. Fig. 7 is the mold made from this machine. The flask for the drag part is made with only a few bars to strengthen it, and when rammed up it is clamped to the machine, the whole being lifted up and rolled over by means of trunnions attached to the machine. It is then set down, the pattern raised, the machine lifted off, rolled back, and made ready for another mold. The core part is barred up very carefully in order to save trouble in setting gaggers, which are usually very few. Fig. 2 is a wheel molding machine for forming the drag part. Fig. 1 is a mold made from the cope part of this same machine. Fig. 9 is a stripping plate machine of a very simple but ingenious design which can be used to make almost anything of a circular nature.

At one time I observed a machine which suggested several ideas to my mind and with which I have made some very complicated castings, reducing their cost fully 25 per cent. and giving perfect work. A general idea of these machines may be had from Figs. 6 and 8. It will be observed that there is only one pin in each plate, one pin in the cope and one in the drag. For these machines we use well-made snap flasks with the holes absolutely perfect. The flasks are made of good seasoned lumber. The pins are turned of tool steel. The plates are planed all over. The sides are planed parallel to each other in order to divide the patterns equally. Grooves are cut into the plate half the depth of the core. A spindle is used the exact size of the core, which serves as a core print, except in the case of large cores, when a core print is turned up with the pattern. The greatest difficulty in making these machines was to get all the patterns absolutely the same in order to have a perfect duplication. This difficulty was got over by our patternmaker, who designed a very simple but ingenious contrivance which is attached to the tool holder of the turning lathe, an illustration of which is reproduced in Fig. 8, showing the tool for inside work, and in Fig. 6, which shows the tool for outside work. We are now constructing a large number of these machines, a great advantage of them being the fact that we only use one plate, and there is no need of expensive stands and levers, the machine being simply placed upon a regular snap bench. The object in using snap flasks is that it saves a large amount of stock flasks and the molds are also much easier to shake out after being cast. We have endeavored to keep all plates as near as possible the same size so that any flask will fit them.

Kranks' Korner.

As is well known it takes the ordinary newspaper to bring out the humorous features of our trade. The quaintest character that ever stuck a shovel in a sand heap couldn't possibly be half as funny as the pencil pusher who, with all the confidence of ignorance, tackles the task of explaining some supposed mystery of the molder's art. Out in Los Angeles there is a party who is no slouch, when it comes to giving secrets away. Perhaps none of us has ever before realized that when the pattern has been buried in the sand and the molten metal run around it there exists a danger of wrecking the mold. Again it will be welcome news to many foundry foremen, who are in the habit of being short of molders Monday morning, to learn that these gentlemen have decided that an alcoholic nerve is undesirable. The Los Angeles story, as it left the maker's hands, reads as follows:

"Earl Hastings, bench molder at the Washington Iron Foundry, is a Los Angeles boy who served his apprenticeship here as an iron molder's helper eight years ago and has since worked at his trade in local foundries. He is a typical workman, possessing both strength and skill, necessary adjuncts to a first-class molder. He says that he started in as a sand digger eight years ago at 60 cents a day, now he is working for $4 a day. Iron molders as a class are fine specimens of manhood. The work around the molds is such that weaklings are only in the way. Skill is a prime requisite of the successful molder, but strength of muscle and iron nerves are also necessary. When the pattern has been buried in the sand, the molten metal runs around it and the mold is ready to be released, the slightest inaccuracy on the part of the molder would not only wreck the mold but destroy the pattern. Iron molders have always been classed as the most

reliable workmen about the foundry. Drunken molders are practically unknown to the trade, the men realizing that an alcoholic nerve is no good at the molder's bench. A good workman receives $3.75 a day and steady employment the year round. The equable climate of Southern California makes it a Mecca for iron molders, but the craft is so well organized that there is no cutting of wages."

* * * * *

I notice that a well-known writer on the subject of brass founding in a recent contribution describes the old way of making driving brasses, where you take any old flask and lie down on your knees and spend more than half of your time making partings. Advice of this kind should really not be accepted at the present time unless the author is willing to offer inducements to get rid of it. In these days of close competition in railway castings, no one has any business to begin the manufacture of journal bearings or car brasses on a very small scale, and it would be a suicidal policy to start at all without proper patterns and matchboards. Even then there would be but little profit. The only way to make money in this line is to fit up a few molding machines specially for this work, when one will secure ten times the output he would from the same number of men working under jobbing foundry methods. Articles like the one referred to in this instance, are all well enough for kindergartens, where there is danger of the parting sand being put on wrong side up, but to the practical man their commercial value is nil. The strange part of it is that such useless matter should be written by one who has been at the head of several noted manufacturing establishments.

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According to an item traveling the rounds of the technical press, Herbert B. Atha, of the well-known firm of steel founders at Harrison, N. J., has been experimenting with a mold wash for steel castings, which seems to me to be rather dangerous in its composition. I know that a little gasoline is the handiest thing to use for removing dampness, and I have also observed several narrow escapes from bad burns through a slight carelessness on the part of those who handled it. At any rate fuels of this character should be carefully guarded against exposure, and it appears to me that where they form the principal ingredient of a mold wash this is difficult to do. The way the papers describe Mr. Atha's method of preventing melted steel from adhering to the sand, is as follows:

The surface of the mold is treated to a composition consisting of a fine carbonate of magnesium, a highly volatile or inflammable liquid, such as alcohol, gasoline, benzine, naptha, or other liquid having a higher volatility than water, and rosin. In preparing the wash, it is preferred to first dissolve in twelve parts of naptha, five parts, by bulk, of rosin, and to one part of this solution there is added two parts of clear naptha and three parts of carbonate of magnesium. The rosin serves to hold the carbonate of magnesium in suspension, so that the coating applied to the mold may be more uniform.

When the mold has been covered the carbonate of magnesium enters into the interstices of the mold, filling its surface, while the liquid of the composition enters more deeply into the mold. Fire is then applied, whereby the inflammable carbonaceous fluid is quickly consumed while the carbonate of magnesium remains, forming with the sand a smooth crust and giving firmness to the surface of the mold. Instead of removing the fluid by fire, it may be allowed to evaporate.

When the liquid steel is finally poured into the mold, the heat serves to drive off the carbonic acid gas from the carbonate, thereby converting the residual coating into an oxide of magnesium, which latter is infusible at the temperature of the molten steel.

* * * * *

For gear cases and similar castings for automobile engines, where lightness is one of the first considerations, an alloy, composed of aluminum 82, zinc 15 and copper 3 parts, is recommended. If greater rigidity is required the percentage of copper may be slightly increased.

* * * * *

There are some shops which never can get enough red tape plastered up around the few acres of ground they call their own. The management of a foundry in Central Ohio some time ago got up a blank form of pedigree, which it intended to have each one of its molders fill out to show his position in the social scale. Among other things it asked for information in regard to the last four places he had worked at, together with the time spent at each and the reason for leaving his last position. To cap the climax the molder was

required to give the names of three good persons who would vouch for his good character.

The molder has always shown a great disinclination to reveal his history. In this instance the firm in question had planned everything carefully, with one exception—it had neglected to consult the molder. With his natural independence he refused to write his own biography, and as good jobbing molders were scarce there was no alternative for the firm but to give up the task of compiling a history of its employes.

But how much better it would have been never to have started anything at all of this kind. It only helped to promote needless friction, and was resented by the employes as interference in matters concerning themselves only. And were they not right? If a man does his work right, minds his own business and makes money for you as well as himself, what right have you to go and attempt to pry into his life at a time when no connection at all existed between you?

* * * * *

Complaining of bronze valves made from a mixture of copper 88, tin 10 and zinc 2, leaking under a pressure of from 300 to 400 pounds, a trade journal offers the suggestion that this may be due to overheating or soaking the metal without a proper covering. Again faulty castings of this character are often caused by oxide or dross in minute and almost invisible quantities finding its way into the mold, preventing a perfect union of the metal at certain points, and leaving what may be termed a channel, through which water will pass under a high pressure.

It is suggested that to overcome such defects the combination of a suitable skimming gate with a horn gate has certain advantages as a preventive of oxide entering the mold. Again, it is pointed out that the addition of a small quantity of phosphorus to the mixture will act favorably and prevent the formation of oxide. This addition should not exceed .02 per cent and is best introduced in the form of phosphor tin.

[The above unfinished paragraph was the last piece of "copy" prepared by Henry Hansen for THE FOUNDRY. It was literally true of him that he died in the harness.—ED.]

The Central Brass Foundry Co., of Cleveland, O., has changed its name to the Allyne Brass Co.

The Invasion of the Sand-Casting Trade by the Rolling Mill.

A brass rolling mill, which manufactures special shapes of brass by a method known as the extrusion process, is now invading, to a certain extent, the field already occupied by the sand-casting industry. This is quite natural and we see no reason why, in certain specific uses, sand castings should not be replaced by shapes made by this method. The extrusion process consists in "squirting," so to speak, brass through various forms of dies while it is red-hot, by means of hydraulic pressure, so that long lengths of various complicated sections are produced. These are afterwards cut up in automatic machines. It will be readily seen that this method has certain advantages over the use of sand castings. This process has been use in England for some time but was recently introduced into the United States.

We predict a future for this process as, coming in long lengths as the shapes do, the automatic machines may be used to a great extent in machining it. We do not, however, fear at all the replacing of sand castings to any great extent by it for the reason that the cast of the material even before cut off is very much greater than that of castings. Again, only certain forms can be utilized; those, in fact, in which every portion is parallel. The mixture of the metal, too, must be kept within narrow limits and those alloys can only be used which will work hot. This precludes, to a certain extent, the use of a free-cutting metal so necessary in machines working at a high speed. Leaded brass, however, may be made in the extrusion machine, but the mixture to which lead is added is hard and the amount of lead small, so that the resultant metal is not, by any means, the free-cutting material that is found in a good brass casting. The extrusion process may be, perhaps, cheapened, but at the same time sand-casting is undergoing a process of evolution in the use of the molding machine, cheap melting, and similar conditions so that brass sand-castings are certain to reach a figure lower than even the present price. Our notion of the extrusion process, then, is that it will open up new uses for brass not hitherto found but will only replace brass sand-castings to a limited extent.—*The Metal Industry.*

The Scott Mfg. Co., Keokuk, Iowa, has started its foundry and will do a general jobbing business in iron and brass castings.

Hoist Device in the Deering Foundry.

A very interesting installation of two special five-ton, two-motor, traveling electric hoists has been made in the No. 2 foundry of the International Harvester Co., Deering Division, Chicago, by Pawling & Harnischfeger, of Milwaukee. The accompanying view shows the two hoists, the plan of support, and sug-

SPECIAL TRAVELING ELECTRIC HOISTS IN THE NO. 2 FOUNDRY, INTERNATIONAL HARVESTER CO., DEERING DIVISION, CHICAGO.

gests the service. The foundry is 820 feet long by 80 feet wide, with an L 60 by 80 feet. The cupola is at the side of the center of the main floor with 400 feet to be served by each machine, or both hoists working at one end, if found desirable.

Castings for agricultural implements are necessarily small, but of great variety and very large quantity. To cast these to advantage, and properly care for the molten metal, requires apparatus capable of very rapid work.

For these castings the hoists are used only to carry the reservoir ladles from which the smaller ladles are filled, either to be poured to the molds direct, or to attach to small hand cranes, which work on each side of the hoist runway. The two inner runways for the crane will be noted paralleling the hoist I-beam.

These hoists are capable of a maximum speed of 500 feet per minute under full load and 600 feet when running light. The capacity is five tons, with a total lift of 17 feet, which is accomplished at the rate of 40 feet per minute under full load and 90 feet running light.

There being but a limited clearance between the floor and the bottom chords of the roof truss, Pawling & Harnischfeger designed a special type of hoist to gain the required lift. Contrary to the usual plan of suspending the drum beneath cast steel hanger frame, the two International hoists have the drum placed close to the I-beam runway by means of a channel steel frame. This change from the standard, and suspending the drum between these channels, required that the hoist gearing with the load brake be placed at the opposite end of the machine than is usually employed. The cage for the operator is so designed and attached as to protect him from the heat from the ladle and at the same time to permit a view of all work requiring his attention. Direct current of 220 volts is used and conveyed to the machine through two trolley wires attached to, but insulated from, the top flange of the I-beam. The cage contains all the controlling mechanism, switchboards, fuses, etc.

Swivel tracks are used upon these hoists, capable of taking curves of not less than 15 feet radius, and, in the entire length of the runway of 1,100 feet, there are four curves and five switches. A curve with two switches is placed in front of the cupola house. From the main runway at the entrance to the L are placed two switches and two curves, the L being used as a rattling room. The hoists are of much service in carrying castings to this rattling room, the view showing such a load attached to one hoist.

A further advantage in using these hoists arises in taking the switch and runway to a landing platform at one side and end of the building, permitting the carrying of sand, molds, flasks, etc., to any point within the building, or the delivery of castings to wagons for conveyance to other departments. The International Harvester Co. has lately ordered a similar hoist for its Hamilton, Ont., Division.

The Cupola Breast.

The making of the breast of the cupola is one of the most important points in cupola management. Through the breast all the iron for the heat must pass, and if it is not well constructed it is liable to give out, in one or more ways, before the end of the heat. In the early days of my career in the foundry, says E. H. Putnam in *The Tradesman*, I was rather impatient with what I regarded as the finickyness of a certain cupola tender in forming, trimming, smoothing and black-washing the breast and the tap hole and spout. That was a good while ago. I was young, and much given to the "hustling" idea, with rather too much emphasis on the "hustle."

Fast work is, in itself, all right; but not at the expense of quality. One should do as much as he can, and do it well; and in the manipulation of the cupola the quality of the work should invariably have precedence. If the cupola is badly managed in any one feature it may result in scaling down the money value of the day's work of every man in the foundry. If the cupola breast gives out when the heat is in the last quarter, the foreman may be glad to see the end of the agony, with a few hundred molds, more or less, left over unpoured. And all will feel a sense of relief if the trouble ends without anyone getting burned. We are apt to ignore the great danger, in a case of this kind, but it is always present, nevertheless.

To make a good breast, after the coke is well afire, insert fresh pieces of coke against the red-hot coke in the cupola, making as smooth a wall as possible, and leaving a space of five or six inches from this coke wall to the outer face of the shell. This space may be varied according to the thickness of the

lining; but for cupolas of from 30 inches to 50 inches diameter, a tap hole 6 inches long will be satisfactory, under proper management.

Having formed the bottom part of the breast of uniform level with the sand bottom of the cupola, and three-fourths of an inch higher than the lining of the center of the spout, take a mixture of one-half sharp sand and one-half fire clay, wetted to the right consistency, and wrap it around the smooth, slightly tapered iron bar with which you are to form the tap hole, and lay the forming bar thus surrounded with the coating of fire clay into the groove scooped out from the middle of the floor of the breast; press it down till the bottom of the bar shall be three-fourths of an inch above the center of the spout, push it hard against the coke wall, throw in new molding sand and ram it in hard. Take a molder's tool and form the front straight up and down. Withdraw the forming bar, and leave the edge of the tap hole flush with the front of the breast. Blackwash with plumbago in water. The blackwashing is important. True, there are many foundries where it is not practiced; and they get along tolerably well without it; some of them very well indeed. But the spatterings of molten iron cling with great tenacity to the bare fire clay and molding sand breast, making it difficult to keep it clean and intact. The breast ought to be in as good condition at the finish of the heat as at the start, and the blackwashing is a great aid to that end. With it, the iron can be readily removed from about the tap hole without crumbling or chipping away any of the sand from the breast at the first few taps, and by that time the sand around the tap hole will become baked so hard that there will be no danger of damage from reasonably careful use of the tapping bar.

The spout, whether short or long, always should be well coated with plumbago wash. This will enable the removal of the solidified iron that may accumulate after putting on the blast and before the first stopping. If a refractory wash is not used, the iron is apt to cling so fast as to cause danger of seriously disarranging the lining of the spout, when it is removed.

Of course plumbago is costly, but not so costly as the troubles that its absence often causes.

I have indicated that the bottom of the tap hole should be three-fourths of an inch above the bottom of the spout. This is another of the unnecessary things, a feature in fact that the majority of melters get along without—just as the majority of melters used to get along without weighing or measuring the stock.

A little reflection will show that a tap hole thus constructed can be more easily and securely stopped than when it is on a level with the bottom of the spout. In the latter case, if as too often happens, an obstruction becomes built up in the spout near the tap hole, it is almost impossible to stop perfectly, and, under these circumstances, the trouble grows as the heat advances. And the difficulty is aggravated when the effort to clear away the obstruction results in opening up the tap hole before the work is done, and the upshot of it is that the melter has to stop up as best he can by raising his hands as high as possible and trying to force the bod hard down at the bottom of the tap hole, but meeting with poor success, for the iron will somehow find its way out in greater or less quantity.

Another point in connection with the cupola breast is to let the bottom and sides of the spout, at the breast, be lined with fire brick. In my own practice the whole of the spout is thus lined. But it is specially important the point at and near the tap hole, because it is sometimes necessary to use a good deal of force in chipping away the obstructive substance that accumulates there, and a less firm lining of the spout would be liable to yield to this hard usage, and so cause trouble and possibly disaster.

It is the part of wisdom to fortify against any possible irregularity in the operation of the cupola; don't take any chances. Acquire the habit of doing everything in just the best possible way till it becomes practically impossible to do it in any other way, and the results will pay you a thousand fold.

If your cupola tender has not the right habits and will not acquire them, do as Dr. Moldenke did, as stated in his recent paper, read at the meeting of the foundrymen's association—let your wiseacre melter find a job somewhere else, and elevate an intelligent and teachable laborer to the position of furnaceman, and, when he demonstrated his acceptability, pay him such wages as will make him wish to remain with you and to please you by his work.

Some melters spoil the tap hole by yielding to over-anxiety about tapping out for the first time. They imagine that if they wait for a considerable accumulation of iron, the iron in the tap hole will become solidified. Remember that the molten iron in the tap hole is in direct contact with the molten iron within and that its temperature cannot be very much less than that of the latter. When the cupola is first stopped up, the process of melting is in very slow progress, and no doubt the first two or three hundred pounds that first comes down is greatly chilled by contact with the sand bottom; furthermore, it may be admitted that the iron in actual contact with the moist stopper probably becomes solidified occasionally; but as the melting proceeds with increasing rapidity and the white hot iron from above comes streaming down, the temperature of the first is raised, and by the time the first tap is properly made the iron in the tap hole will be in a fluid state once more. Whereas, if the tap is made too early, a solid obstruction of iron may be encountered, and, in the drastic measures to remove it, the tap-hole is spoiled and the rest of the day's work becomes a painful experience instead of the agreeable part that it might have been.

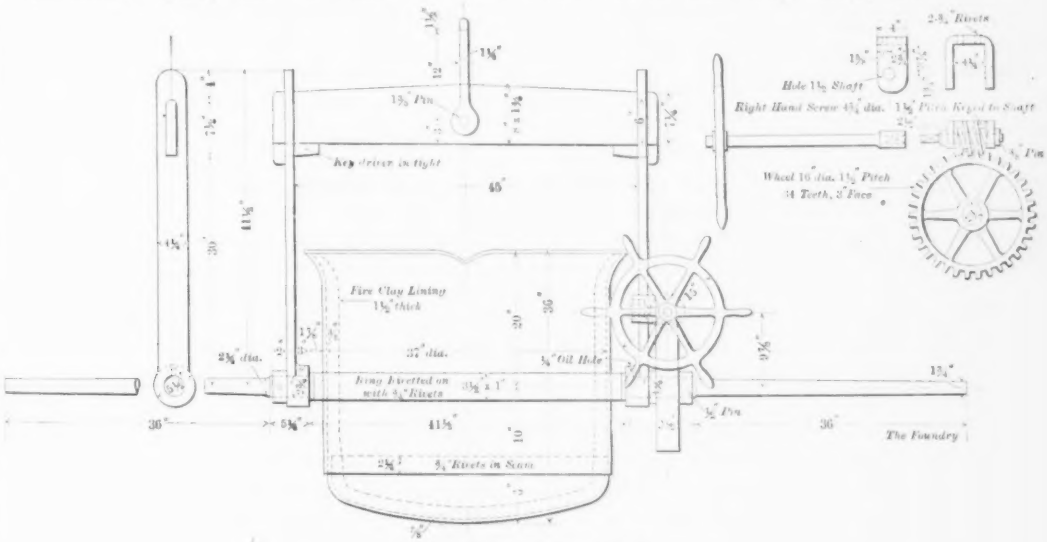
I said above, keep the edge of the tap hole flush with the front of the breast. Some melters ream out the front of the tap hole as a molder reams out the top of the pouring gate. In this latter case, the stopper wedges in so hard that it is difficult of removal, it cannot be kept clean, and in tapping out, the shape becomes distorted and a great deal of unnecessary trouble ensues.

Where the tap hole is left flush with the front, a very little agitation with the bar will enable the molten iron to force away the stopper, and the breast and tap hole will remain intact.

The stopping material should consist of new molding sand and fire clay, say one-half of each, or varied to suit. Fire clay alone is, in my opinion, too strong, while molding sand mixed with flour is inferior to the mixture of clay and sand.

A Three and One-Half Ton Foundry Ladle.

I show with this a sketch of a 3½-ton ladle, which can be made very cheaply with such material as is generally found around most shops. The ladle is 37 inches in diameter inside and is made of ⅜-inch tank steel with a dished head in the bottom, has a ring 3½ inches wide by 1 inch thick at center, gradually thickened up at sides to 1½ inch. The arms are welded to this ring which forms a shaft for the upright bars, and also serve as guides to steady the ladle. A removable hand wheel is attached to a worm, which is fastened by a bracket to one of the uprights and meshes with a gear on shaft. The ladle has each side dished to form a spout for pouring and has a lining of fire clay 1½ inches thick. It can be adjusted to a nicety and the extra amount of weight on one side caused by the

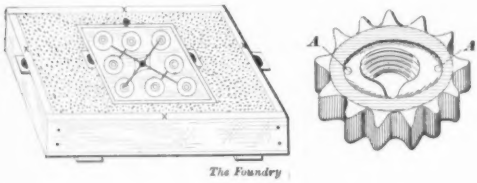


A 3½-TON FOUNDRY LADLE.

hand wheel, worm and gear does not amount to enough to throw it off its balance. This ladle has been in operation for over 10 years and outside of renewing lining has not cost one cent for repairs. G. E. LEE.

Match Plate Molding.

The use of match plates is old, indeed. They have been employed for more than a century. One reason for their not being used more extensively is that they require a master pattern. If six or eight pieces are wanted it requires just so many master patterns. Yet many patterns can easily be match-plated if the



The Foundry

job is properly and carefully done. Let us take, for instance, eight small gear patterns, say three inches in diameter, and having 12 or 14 teeth. These will go into a 12x12-inch snap flask. We will first drill two holes, as at A A, and tap these for a 3-16-inch stove bolt with flat head. Let the screw come flush with the bottom, leaving the head sticking up one-half the thickness of the match plate, so that it will not come through.

We now have eight finished patterns with two holes tapped in each. Have a good sound flask large enough to mold the plate and place your patterns on a mold board. Have some strips 3-16 inch, or at least not over ¼ inch in thickness. Two of these are 13 inches in length, the others 12 inches. The strips will assist in setting the patterns on the mold board in the proper position. Place the nowel where wanted, ram up, turn over, and smooth the parting carefully, keeping the sand sharp up against the pattern. Put on the cope and ram this up with two screws. When the cope has been rammed, take the large strips and brad them to the nowel; then lay the small strips on same. Fill between these with carefully prepared sand and smooth it level. Then draw the small strips. Draw the first gear pattern, brush off carefully, and insert the two flat head screws, leaving just enough so it will not come through the plate. Carefully put it back just as it came out, having marked a tooth to make sure. Use a sleek to keep the sand up against the pattern and then draw the balance of the gears in the same manner. When all is finished gate the mold and pour it and you have a pattern for machine or hand molding without a master pattern, and all of this is practically finished and can be pickled or cleaned as desired.

I would advise an amateur to take one gear casting, put it on a piece of board, having two holes tapped, of course; mold it, draw the board, then draw the gear and put in the two screws, gate and pour. He will then see how he succeeded before making his pattern. Many other castings can, of course, be made in this way on match plates. The form of pattern shown in the illustration is best gated by soldering a gate on to the plate.

PATRICK SHIELDS.

Economical Heat for Annealing Ovens.

The recent trials of pulverized coal as fuel for annealing purposes, are a very good indication of the wish to get away from the old methods of coal firing wherever a uniform and continued heat is desired. The ideal fuel naturally can be nothing other than a gas, but as this is not everywhere available it must either be made, or its advantage attained by a more or less roundabout process.

Touching briefly on the available fuel gases we have the following: Natural gas, with its high calorific value, ease of application and regulation forms the most desirable fuel. It enables the annealer to shut off the dampers of an annealing oven almost completely when full heat has been reached, and thus in checking the circulation of air about the annealing pots increase their life very considerably. Where care is taken to allow the gas to enter at a few ounces pressure and from very large pipes, a good combustion is obtained and astonishing economies effected over the ordinary way of simply turning on the valve and letting enough gas stream out at any pressure there may happen to be in the main sufficient to get a flame of given length.

Natural gas, however, will not be with us always; in fact, usually peters out when freezing temperature arrives, at least for manufacturing purposes, and so the next thing to consider is producer gas. The advantages of this are in the comparative immunity from stoppage, as simple foresight with regard to the coal supply, and enough men to draw upon

should furnish a steady supply of this comparatively poor but effective gas. Where the natural gas supply is reckoned by the thousand cubic feet, producer gas foots up to millions of cubic feet per day, hence large conduits or gas flues are necessary to convey it to its destination. It has the advantage of a high initial temperature, but is only one-tenth the calorific value of natural gas, or the equivalent weight of fuel oil.

For annealing purposes it takes considerable ingenuity to provide proper apparatus for successful burning, the sooting up of the flues and the deposition of gas carbon making life a burden to the annealer where this does not obtain. Once, however, the currents of air and gas are so arranged that a natural mixing takes place, and in addition the apparatus be kept from getting too hot, very little attention beyond the regular burning out is necessary.

The main disadvantage of producer gas lies in the great volume which must be sent into the annealing oven to produce results. Over half of the gas is inert nitrogen, which must pass through the oven, be heated up a little, and then take an exit past the dampers. This means a lot more air to burn the gas, and the sum and substance is a very serious oxidation of the annealing pots. The gas is not hard on the ovens, and has the advantage of being gas, even if a poor one.

Turning now to oil gases, whether carried with air and steam, or simply oil run into the oven in the natural state. This is also a gas fuel, so to say, although the gas is made right in the combustion chamber, and is a very rich gas indeed. It is, however, of very local effect, producing the most powerful heat at the corner of the oven where it enters, burning out the oven badly at that spot, and overheating the iron in the surrounding boxes on occasion also. The advantages of oil are great, but the business disadvantages are so also, one never knowing about the price to be asked at the making of the next contract.

Blowing in powdered coal would seem a very simple method of getting the full value of the fuel, and doing away with all the annoyance of the labor end of it. Where the coal is ground to an impalpable powder, there is no doubt at all that a splendid combustion must take place, this having been amply proven by experiments with powdered coal for firing boilers. It seems, however, that where the coal is not ground fine enough, the results are not at all satisfactory, that the flues are clogged up with ashes, which should pass into the base of the stack if not altogether out of it with the draft therein.

It is questionable whether the objection to producer gas in regard to the entrance of too much air and valueless gas constituent, so far as it affects the life of the annealing boxes, will not also hold good with powdered coal fuel, and that therefore this method, which must require considerable attention, loses the advantage of a direct use of the coal without the labor of hand firing. On the other hand while about ten percent of the fuel value of coal is lost in its conversion to producer gas, no such loss should be charged up to the powdered article, and perhaps, the other troubles and advantages being about equal, this may make the powdered coal the more desirable fuel for annealing purposes.

The conclusion which one naturally reaches from the above review of the pros and cons of each fuel, is that while natural gas will be found best wherever available, and oil where obtained cheaply, the future will see methods of firing annealing ovens other than by the old hand process, divided between producer gas and powdered coal. It will therefore be of great interest to get the facts of the latter installations for general comparison, and extended experiments with powdered coal for fuel purposes should soon be the order of the day.

RICHARD MOLDENKE.

The Trials of the Foundry Foreman.*

BY A. M. LOUDON.

The skill and endurance of the foundry foreman are constantly and sorely taxed in every phase of foundry life. Indeed he is in the unenviable position of being between two fires as it were, and life is therefore to him a pretty miserable affair.

Let us say that an order has been secured for the foundry, when the foreman must at once figure on the best method of making the castings at the lowest cost. The ledger must necessarily show a profit so far as he is concerned. While doing this he must also direct the work of each man employed about the shop, supervise the cupola gang, and see to it that the best results are obtained there. Next he must look after the molding proper, give

*Paper read at the Milwaukee meeting of the A. F. A.

out the work and oversee the core making, arranging things so that the cores will be made in time for the molds they are intended for and the latter poured in proper rotation.

If to the above are added daily conferences with the office, an even temper and smiling countenance can hardly be asked from the hard worked foundry foreman. It would seem further that if those who come into daily contact with the foreman would assist him wherever possible, perhaps he might cultivate that pleasant and cheerful appearance which seems so desirable in business life.

In general the foundry foreman has altogether too little assistance, whether he is at the head of a jobbing or a specialty shop. He naturally becomes a machine in the end, and if he breaks down in spirit, he is set down as a crank and certainly unfit to run a foundry.

The foreman has also to contend with the peculiarities of his men. And while I know that in most shops he is fortunate enough to have some good, honest, conscientious and capable men who do not trouble him, the majority of the help is always trying to see how little may be done before the law is laid down hard. Any effort on the part of the foreman meets with tacit resistance, and if the work is exacted in spite of this, every means are resorted to, to drive him out.

On the one hand we have the foreman who allows the molder, helper, and core-maker to set the day's work. This man is not worth his hire. On the other hand we have the man who knows what a day's work should be, asks it from every one, and will not put up with a refusal unless it is actually shown by honest effort to be impossible of accomplishment. This foreman will turn out the shirkers.

Necessarily it will be seen that to do justice to the firm and the men is a delicate task, and the art is given to few. But here is just where ample assistance will help very much. Friction will be reduced to a minimum, and all the contending elements will be held down to strict business.

To get the best results from a good foreman, the management should give him its full confidence, back up his efforts to better conditions at all times, find out his troubles and wherever possible smooth the way a little so that the result gives some personal satisfaction to him and encourages him. Do not worry or ridicule the foreman, for he is the very man who worries most over losses, and does his best whether backed up or not, to reduce them, from personal pride. He will do all he can to keep up the production to the maximum, and if instead of worrying him when a loss does occur, which is only sure to aggravate his difficulties, he is encouraged and given to understand that the management is with him in his efforts to locate and correct the trouble, a very happy situation will result.

As to molders, let them begin work in the morning promptly, taking the jobs given to them with the best interest of the management at heart, for who knows when it may be a molder's turn to be foreman. He who may be depended upon to work conscientiously and intelligently has a foremanship ready for him when his time arrives. If molders would only keep this in mind, there would not be so many tyrants made in the foundries by their obstinacy and disregard for the interests of their employers. Would the molders only unite to help the foreman, how nice a place the foundry would at once become for honest, comfortable work.

CAST IRON NOTES.

Devoted to inquiries from Practical Foundrymen on the subject of Melting and Using Cast Iron. Address all inquiries to W. J. KEEP, care of The Foundry.

DOES THE COMPOSITION ALWAYS DETERMINE THE PHYSICAL QUALITY OF CASTINGS?

Question: About a week ago our shrinkage rose suddenly. In order to bring it down we increased the silicon and kept adding until we found that the iron had an overdose, proven by its grittiness and toughness in drilling. We then reduced the silicon about 40 percent and the shrinkage came down. Can you explain this?

Answer: The chemist of a large Western foundry happened in a few days ago and I mentioned this case. He asked: "Do you not think that other elements than silicon influence the physical quality?" While I agreed to this, yet we both agreed that a variation of silicon was the only practical way by which a founder could vary physical quality.

There are exceptions to the general rule that increasing silicon decreases shrinkage and increases the strength of thin castings, while if the same iron is put into large castings strength is decreased. Yet this is so generally true that if we strike an exception we may

be absolutely sure that, as the chemist said, the change was caused by another element.

What are we going to do about it? If we have made a change in coke or in any iron or have received a new car of flux, drop back to material that produced desirable results and then by analysis or trial find if any of the new material caused the trouble. It would be practically impossible to determine the trouble by an outside chemist. A chemist at the foundry, if he had made an analysis of each car of material received, might be able to discover deficient carbon in some iron by further analyses. A founder cannot discontinue operations to allow anyone to find out the seat of the trouble and he must change at once to save losses. When he gets straight again he cares very little whether his trouble came from some variation in sulphur or carbon that could not have been discovered by ordinary chemical foundry analysis.

I have before spoken of my own experience with a car of limestone which contained an excessive amount of sulphur. This in one cast so increased shrinkage and hardness in the castings that they could not be drilled. We could see the glistening pyrites in the stone and next day used limestone from the other side of the pile and the shrinkage came down and castings were soft. We got our castings right several hours before the chemist's report on casting and stone was received.

Changes in silicon will not always produce identically like results, but the results are generally so regular as to give us the greatest confidence in controlling the physical quality by varying silicon.

MOLDING MACHINES FOR STOVE WORK.

The present custom of changing patterns every few years makes it impracticable to use machines to any great extent. Squeezers can be used to advantage on much of the open gas stove work and on quite a number of pieces of ordinary stove work. If the work is adapted to the squeezer or machine better castings can be made than by ordinary molding. The chief benefit would be that unskilled labor could turn out as good work as an experienced molder, or a union molder could turn out 25 per cent more work than by hand, but they will not do it.

THE USE OF CAST IRON BORINGS IN THE CUPOLA.

I am asked about this very often, though the question has been answered in this column several times.

Do not let the borings get rusty. Pack them as they accumulate each day in boxes holding 100 pounds. Use 1-inch cull lumber for the boxes and nail solid. Charge the same as pig iron, using to begin with one box of borings to 1,900 pounds of pig. Increase the proportion until you use all of your borings. The effect will be to close the grain in your castings, to prevent spongy spots and lessen internal shrinkage. You will find very little loss in weight so that your borings are nearly as valuable as any other small scrap.

The Use of Aluminum for Automobile Castings.

One of the special qualities sought in castings to be used in the construction of automobiles is lightness, and for this reason aluminum is finding considerable favor. According to the *Metal Industry* the use of this metal for this purpose has settled down to two principal alloys, one consisting of aluminum and copper and another made up of aluminum and zinc. In the former seven per cent of copper makes a very satisfactory material and while not as strong as the aluminum-zinc alloy, it is sufficiently so for most requirements. The redeeming feature about this alloy is the fact that it casts remarkably well, even better than pure aluminum. Very complicated shapes, which, made of the aluminum-zinc alloy, would crack, can be easily cast from this. On account of the small quantity of the alloying material the alloy is much lighter than the aluminum-zinc alloys. Successful casting, like any of the aluminum alloys, requires care in melting and what applies to the casting of the aluminum-zinc alloys applies equally well to the aluminum-copper compounds. If seven per cent of copper gives an alloy which is not tough enough, then four, five or six per cent may be used, depending upon the requirements. The seven per cent alloy, however, is the one generally used for work requiring a stiff metal. Its tensile strength is between 15,000 and 20,000 pounds per square inch in the average sand casting. If great care is used much higher tensile strength may be obtained. Those who experience difficulty in casting aluminum-zinc alloys should try this class of alloys. If a casting cannot be made from them something must be wrong with the pattern.

Alloys which consist of aluminum and zinc are quite attractive to the foundryman on account of their strength and cheapness. However, if not properly cast they are very un-

satisfactory, and under poor casting conditions come out of the sand in a much weaker condition than the aluminum-copper alloys. For ordinary use an alloy consisting of 75 per cent of aluminum and 25 per cent of zinc is the best. Scrap aluminum may be used in the form of skeleton sheet. On no account should chips or a miscellaneous assortment of scrap castings be used. We have obtained excellent results in the use of skeleton sheet and ordinary spelter. Refined spelter is unnecessary. If properly cast a tensile strength of 35,000 pounds per square inch may readily be obtained in small green-sand castings. In order to obtain it, however, the following precautions must be carried out to the letter; otherwise a tensile strength varying from 10,000 to 15,000 pounds per square inch will be the result.

Don't overheat in the fire. As soon as melted and at the proper temperature remove and pour. A common fault in the shop is to have the metal melted before the molder has finished his molds. This necessitates holding the heats and such a condition is very injurious to the quality of the metal.

Pour at the lowest possible temperature at which the casting will run. This precaution is the most essential of all, for the hotter the metal the lower the tensile strength of the casting. A phenomenon of this kind explains the great diversity of results obtained in the strength of aluminum castings. Skim thoroughly before pouring.

By observing these precautions, especially in regard to temperature, the difficulty of making strong aluminum castings will be greatly diminished. By pouring two test bars from the same crucible, one at a bright red heat and the other at the lowest possible temperature, we have obtained results on test bars which varied by nearly one hundred per cent. The bar poured at the bright red heat was only about one-half as strong as the other.

In the pattern lies one obstacle with which the aluminum foundryman has to contend. If the aluminum-zinc alloy is to be used the corners should not only be filleted, but even rounded as this alloy is apt to draw in or crack in such places. The ribs and other portions should be well proportioned, for, as previously mentioned, good work requires a low pouring temperature, and unless the pattern is so constructed the casting is likely not to be completely run, through the thick portions taking all the metal before it has a chance to fill the thin places. Risers should be put on all heavy parts, and as many gates as possible should be used. The gear cases of an automobile are usually very complicated patterns to mold, and especial care must be given to the core. If made in green sand or if the pattern makes its own core, arrangements must be made for allowing it to contract when the metal is cooling. In the case of a dry sand core the same rule applies, but, of course, the core can be made "rotten" by means of rosin or similar compounds. A hard, unyielding core means a cracked casting.

Many founders begin to loosen the sand as soon as the casting has set, but this practice requires great care; otherwise the casting may be strained by the loosening bars. In the casting of a large gear case for an automobile as much of the pattern as possible should be molded in the nowel, as the metal will then flow down instead of over the core as it would have to do if cast in the cope. There is an aversion to this, we know, but many castings, on account of their extreme thinness, cannot be cast in any other way. We have cast many automobile cases in this manner, poured them with four pots and loosened the sand after the metal had set; the results were usually good, though, as in any similar work, we occasionally lost some. The "wasters" were usually those which did not run, although we occasionally had a cracked one. Our attempt to pour the metal at a very low heat rendered it difficult to have all come out good. We advise those who are experimenting along this line to use every means within their power to pour at a low temperature, as the tensile strength is then high and the alloy less liable to crack. Dry sand molds greatly aid the running of a difficult casting by preventing the metal chilling as rapidly as it would in a green sand mold.

Heating and Ventilating of Foundries and Machine Shops.

BY H. W. CARRIER, BUFFALO.

Heat losses occur in a building from two causes: First, by the direct transmission of heat by radiation, through the walls and exterior surfaces of the building, and, second, by the infiltration of cold air from without. In designing a heating plant the first of these losses may be very accurately determined by

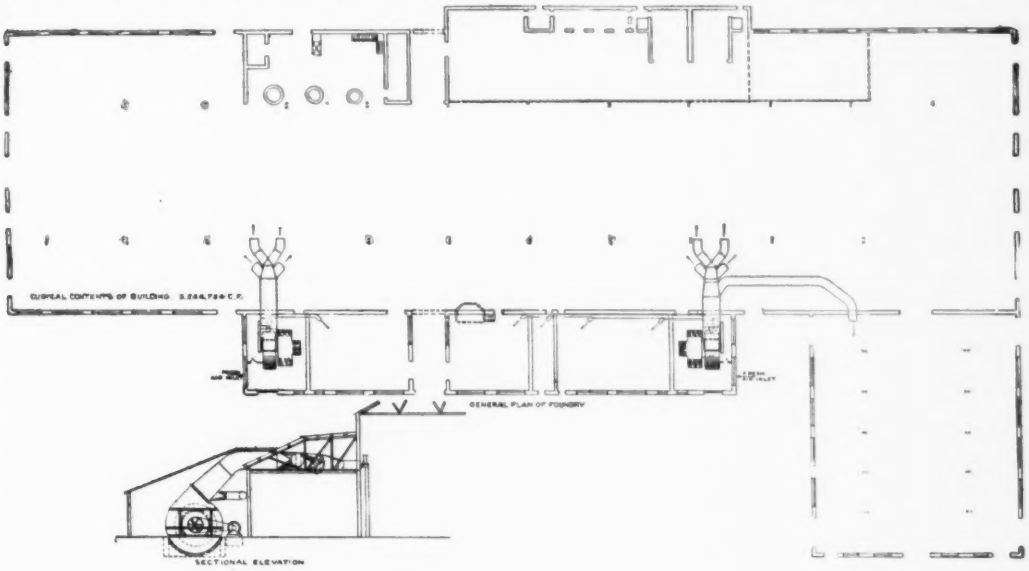
*Abstract of a paper read at the Milwaukee meeting of the A. F. A.

referring to tables which have been prepared showing the amount of heat radiated under different conditions through the various thicknesses of walls, windows, doors, roof, etc. The heat lost through infiltration varies so greatly in various sizes and constructions of buildings that no definite rule can be given. The allowance to be made for this is necessarily a result of experience and a careful test of previous installations.

In either fan or direct radiation systems difficulty is liable to be experienced from the heated air immediately rising and forming a stratum of heated air just beneath the roof. In machine shops and foundries, owing to their height and to the great amount of skylight surface which is always provided in the best modern construction, the loss occasioned by this action of heated air may be considerable, and its prevention is a serious problem. With the fan system, however, the distribution of the heated air is entirely mechanical and affords an opportunity for utilizing its heating effect to the very best advantage. Various methods of distribution have been devised with the fan system whereby the effect of a rising current of heated air is almost entirely avoided. These systems, in general, depend upon securing a perfect diffusion of heated air along or near the floor line and will be described in detail later.

A second difficulty experienced in high buildings is the effect due to outward leakage of the heated air at the upper part of the building and a consequent inward leakage of cold air along the floor line. In large shops this layer of cold air may frequently be found to extend from 4 to 6 feet above the floor, while the amount of heat lost due to the high temperature in the upper part of the buildings may be much more than sufficient to secure a satisfactory heating effect throughout if properly applied. The most effective remedy for this evil is to maintain a slight pressure within the building by means of a fan, which takes a portion of its air from without.

A third difficulty presenting itself in buildings covering large area and having a large



HEATING SYSTEM IN THE FOUNDRY OF THE GENERAL ELECTRIC CO., SCHENECTADY, N. Y.

amount of skylight is the cold down draft, which the cooling effect of the skylights has a tendency to produce. In very wide buildings where heat is distributed only along the walls this effect is noticeable, and as it comes directly upon the heads and shoulders of the workmen and is in the part of the building most used, it is very objectionable.

METHODS OF HEATING.

In general, buildings may be heated in two ways: First, by keeping the walls and roof warm. This is accomplished in the direct radiation system by placing coils along the walls, and in the fan system by blowing the heated air toward the walls. A second method

is to heat the air within the building directly. This can be accomplished in a satisfactory manner only by an indirect or fan system. Of these two systems it may be said that if either is used exclusively the second method is preferable, since it is the more economical. In the first method it is quite evident that if the walls be kept warm, radiation will not occur to any great extent from the interior of the building, and the heating effect will be satisfactory. On the other hand, it is equally evident that the radiation through the walls caused by heating them to a higher temperature occasions a much greater radiation loss than would occur if the room temperature had been secured by heating the air directly. Since the heat transmitted by wall coils is chiefly direct radiation the loss occasioned by the direct transmission of heat through the walls with this system is very great and may be as high as 25 per cent. or more of the total radiation.

With the fan system the method of supplying and distributing the air in the building is the consideration of chief importance. The usual methods of supplying heated air are, first, where the air is taken entirely from without doors and is forced directly into the building through the distributing ducts. This method is generally known as the plenum system, and the pressure produced in the building causes a continuous exit of air from the building, either through the natural openings, as is usually the case in factory and other large buildings, or through special vent openings provided for the purpose, as in public buildings.

A second and more common method for shop buildings where forced ventilation is not a necessity is to draw the supply of air entirely from within the building and again forcing it through the distributing ducts. This causes a continuous circulation of the air within the building, and when properly applied secures excellent results.

The first of the above methods has the advantage of securing an excellent ventilation, and in the instance of foundries this is often desirable. Another advantage possessed by the plenum system is that it produces a continuous outflow of air through all the crevices and openings in the building, which would otherwise be admitting cold air from without to settle along the floor and prevent satisfactory heating. In buildings of loose construction this is frequently the only system which can be successfully operated.

The air return system often has an advantage over the plenum system, in that all the heat supplied to the air is effective in heating the building, but does not possess the advantage of producing a plenum in the building.

IDEAL SYSTEM.

The ideal system is a combination of the plenum and return systems and should always be used where possible. In this system the great portion of the air is returned to the apparatus, but sufficient air is continuously taken from without through a fresh air connection to create a plenum within the building and prevent the inward leakage of the cold air along the floor. In this manner the natural leakage is supplied, not by inflow of cold air through the crevices around the doors and windows, but by air passed through the apparatus and heated to an effective degree. This system has been found by test to be more economical than air return alone. The proper amount of air to be introduced from without is determined by securing a point where the noticeable inward flow of air around the doors or windows ceases. If the plenum is carried beyond this point there will be a loss due to unnecessary heating of the outdoor air.

SYSTEMS OF AIR DISTRIBUTION.

There are several systems of distributing the supply of heated air. A method usual in public and office buildings, and sometimes employed in factory buildings, is the vertical duct system by which the air is admitted through vertical flues or ducts built in the walls at a point about 8 feet above the floor. A method of distribution quite similar to this is one where the air is first blown into brick ducts placed underneath the floor. From these ducts vertical galvanized iron risers are arranged along the walls.

This system is also frequently very successfully employed in foundries. Advantages of this system are, first, that there is no overhead piping in the way of cranes, etc.; second, that the greater portion of the distributing ducts are brick and are not subject to deterioration. The third and principal advantage is that the air can be distributed by this means where most needed. This system is sometimes somewhat modified by placing the outlets close to the floor and blowing downward directly along the floor. This secures a

perfect diffusion of the heated air at the floor line and avoids any drafts which would be objectionable.

Another system which has proved very satisfactory is that in which a distributed air return duct is employed. This approaches very closely in principle to the plenum system used in public buildings, and is a combination of both plenum and exhaust systems. In the Philadelphia & Reading shops at Reading, Pa., instead of employing one or two large units, seven separate sets of apparatus have been provided, placed in small fan houses built at intervals at either side of the building. The peculiar feature in this and similar installations is that no distributing ducts or piping for the heated air are used; the air being blown directly into the building at about 8 or 10 feet above the floor through an outlet branching in three directions, and through which the air passes at a comparatively high velocity. The distribution is effected entirely by return vent ducts, distributed at frequent intervals along the walls, opening into large return air tunnels, which are provided on either side of the building and serve the additional purpose of affording a convenient place for locating steam and water mains, and also electric light and power mains. Provision is made for taking a portion of the air from without doors to secure a plenum. One great advantage of this system is that it removes all cold air leaking into the building at the floor line, as well as that produced by the cold down draft next to the walls. Further, a perfect distribution is secured in all parts of the building, and the cost of installation is reduced to a minimum.

Excellent results can be secured by the use of overhead piping, providing it is not placed at too great a distance above the floor. The chief advantage of the overhead system is the saving in first cost, since on account of the high temperature and velocity of air in the distributing pipes a great amount of heat can be transferred with a very small amount of material. The cost of the galvanized iron distributing system of air ducts is usually a small portion of the total cost. The best results are secured with outlets at from 12 to 18 feet. Above this height it is preferable to use drop pipes extending downward along the columns where they will not interfere with traveling cranes.

In many instances a system of elaborate distribution is impracticable or undesirable. In such cases a centrally located apparatus or discharge pipe may be used. From this point the air is blown in all directions, and a circulation is produced by an exhaust connection to the fan inlet. In such instances very effective heating has been secured even where it was required to blow the air long distances. Perhaps as good an example of the successful operation of such a system may be found in the installation in the foundry buildings of the General Electric Co., at Schenectady, N. Y. This foundry, which is probably one of the largest in the world, is heated in an entirely satisfactory manner with a few large branch outlets. Since the plant was installed a large addition has been built on one end of the building. This addition is satisfactorily heated by a branch inlet situated at over 200 feet from the further end, which shows how thorough a distribution may be secured by a forced circulation.

The Manufacture of Car Brasses.

Answering an inquiry on this subject, in which it is stated that car brasses are being sold at 14 cents per pound, the *Metal Industry* replies as follows:

The manufacture of car brasses is an industry in which the profit is determined by several conditions, viz: 1. The use of scrap metals; 2, the employment of the molding machine; 3, large sales. There are many formulæ for car brass mixtures, but in the cheap mixtures the formula is only approximately maintained. The average composition of low-priced car brasses is as follows: Copper, 70 per cent.; lead, 14 per cent.; zinc, 10 per cent.; tin, 6 per cent.

"On calculating the cost of this mixture, it will readily be seen that little margin is left if new metals are used. The only salvation of the car brass maker is in the use of scrap. Even in the use of this material the profit is very small and the maker relies on a large business to reimburse him. The boxes are furnished with so-called babbitt metal lining in the freight car boxes, which slightly cheapens the cost as the manufacturer obtains a good price for the lead and antimony mixture used for the lining. Only the cheapest antimonial lead is used for this purpose."

Notes on Estimating Methods.*

BY WM. HANSON.

As the question of uniformity in office methods of estimating on castings is beginning to attract some attention in foundry circles, I append some blanks in use by me to facilitate and at the same time properly record the data used.

The cost of the melted iron I obtain from the daily reports which give the irons used for the work in question and may, of course, be varied to suit different castings. One of the blanks shows my method of obtaining the detailed cost of these. The headings explain themselves, a special column being allowed for additional expenses from whatever source these are expected to come. On the same sheet is given the summarized estimate of castings. The whole gives a clear tabular statement upon which to build when sending out estimates on work.

Metals				Fuel				Flux	Labor	Pow'r
				COKE		WOOD				
Brand	Weight	Price	Value	Weight	Value	Quantity	Value			
Total		$								
Pig bed										
		lbs.	$							

$.....

lb. ..... per lb. Average Cost.

Date .....

Supt. .....

Detailed Estimate of Castings.

DRAWING	Moulding	Helping	Core Making	Iron Melted c. per 100	Cleaning	Shipping	Crane Rate	Supplies	Weight in Pounds	Cost of one casting	Additional for expenses	Cost per pound	Date ..... REMARKS

Summarized Estimate of Castings.

DRAWING	No. of castings required	Total weight	Cost per pound	Price per pound	Total cost	Total value

BLANKS FOR FOUNDRY ESTIMATES.

*Presented at the Milwaukee meeting of the A. F. A.

Permanent Molds.*

BY JAMES A. MURPHY.

The casting of large work is at all times an interesting topic to foundrymen, particularly so in loam, when special rigs are involved. The art of loam molding has reached a wonderful degree of perfection in some sections of this country, and the best practice is being directed to the saving of as much as possible of each mold in order to reduce to a minimum the cost of all castings after the first. In other words the permanent mold is the object sought.

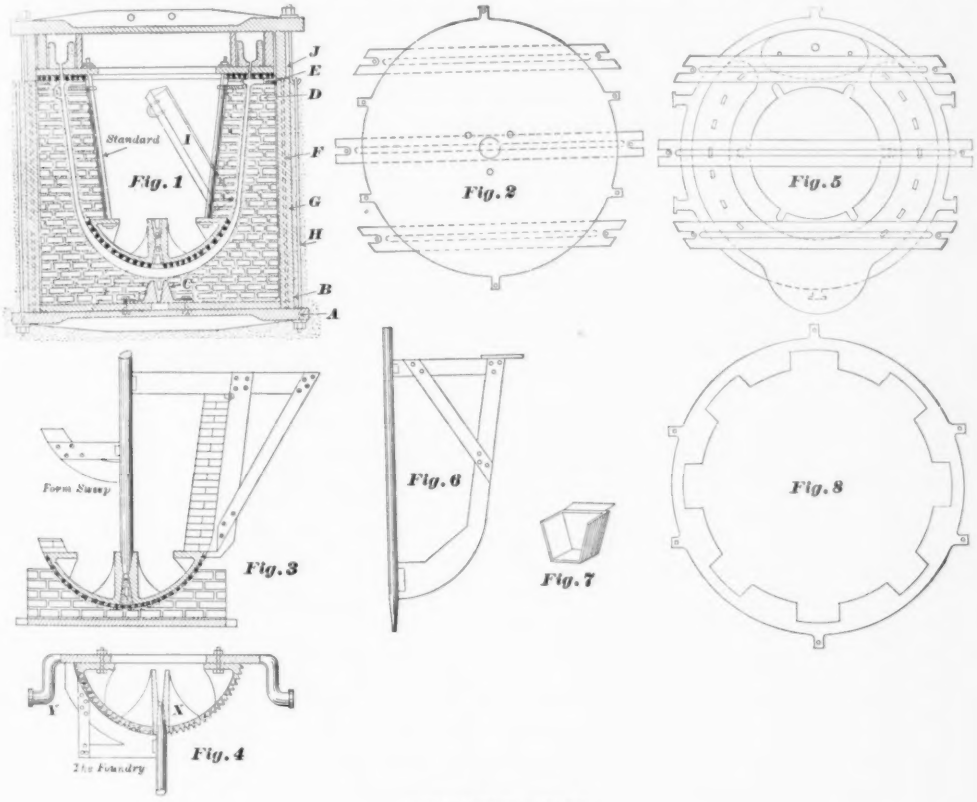
It is a common argument against loam molding that its cost is too high, and I have no doubt but that this is true when work is made in loam that should be made in sand. As a rule those whom I have found prejudiced against loam on account of its cost knew so little about it that I could not consider them competent judges.

*Paper read at the Milwaukee meeting of the A. F. A.

Large kettles, such as shown in Fig. 1, pans, domes, pipes, etc., are cheapest made in permanent loam molds. In some instances iron casings would be still cheaper. There are shops that make such castings in sand, but I consider them not up to the modern way of doing things. The kettle shown weighs about 14 tons and is made very quickly when the proper rigs and equipment are available.

The mold is absolutely permanent, the only preparation necessary being the daubing on of the loam, blackening it, and as the bricks are hot when in use a small fire placed inside of it will dry it thoroughly in a few hours. The core is swept up and is preferably dried in an oven. The whole core can be made of iron staves, but I consider the rig shown with the greater part of the core laid up with brick the quickest, safest and most satisfactory.

To start the job we must dig a pit in the floor in some convenient place and have the binders A and bottom plate B (Fig. 1) made and set, as well as the spindle step C, in which to set the mold sweep (Fig. 6). Bricks are



PERMANENT MOLDS.

then laid to the outline allowing from ½" to ¾" for loam. If the bricks are not of good quality it is best to have the face of the mold laid with fire bricks, using the common ones for backing. When built up to within about a foot of the top it is best to get on the octagonal lines and on their centers build in 8 iron frames (Fig. 7 and D Fig. 1) with liberal draft. In these can be set cores for handles, brackets or other external projections and when the casting is taken out the wall will not be in the least disturbed.

On top of the wall lay a strong cast-iron ring (Fig. 8 and E Fig. 1) recessed on the octagonal lines sufficient to clear the iron boxes just mentioned, leaving space enough on top for a face of loam on the joint. This when bolted down firmly (F Fig. 1) to the bottom plate will prevent the loosening of a single brick. The brick part of the mold being finished, the columns G and bolting rods H are placed and the nature of the soil will have to determine whether a curbing is necessary or not before ramming up the mold permanently. Plenty of fine cinders should be used between the brick work, bringing all the gases to the outside of the wall quickly, where provision should be made to convey them away.

For the core it is best to make one or more crown plate (X Fig. 4) and I consider the one shown an improvement on any similar "get-up" that I have seen. It is cheapest and best when swept up in loam with a straight hole cored through its hub, which can afterwards be machined to suit the taper of the spindle. It can be laid on the roll-over plate (Y Fig. 4) spindle set in the plumed true, loam rubbed on, swept and finished; when hardened with a fire basket, it can be turned over, set in the form as shown in Fig. 3, spindle set in the other side and the building of the core proceeded with. To provide for shrinkage and prevent extra labor and save some bricks from being badly broken, it is handy to build in a splitting bar (I Fig. 1), which can be easily pulled away with the crane after pouring, allowing the wall to give with the contraction of the casting.

When the core is built, an iron lifting ring is secured on top of it, and by means of this it is set on a form similar to Fig. 3, on the oven carriage. When dry this is taken away and the flat top plate J lowered on it, and the core bolted securely to it. The whole thing is lifted by the top plate and closed by the center lines. I prefer running this on top similar to the way shown, each gate being stopped until the runner is full. Risers left open to relieve the pressure of air, prevent the back kick and thus obviate the wrinkles that would mar the appearance of the casting, particularly so if the metal was not very hot. The riser basin should be ample and be so arranged that it can be flowed off to take away the metal from the runner so as not to have a heavy piece of scrap to break.

The mold is thoroughly secure and not much more costly than if only one casting was intended to be made. As shown, it will last for several years continuous service. Any shop equipped for large work should, with a rig of this kind, turn out one of these kettles every few days. As thus arranged it is seldom that a first-class workman need be put on the job, everything being made to prevent possible mistake by other than the grossest carelessness. It is, however, advisable for the foreman to keep an eye to starboard in any case, as I recollect a case where after everything was seen to and considered safe, the unlooked-for happened. It seems that a bag of hay used by the molder at a seat for the ladder was forgotten by him in the mold at the last moment; of course the casting was lost by having a large hole in its bottom, all of which makes one wish that the molder had forgotten to come out also.

Combination Iron Flasks.

In providing itself with iron flasks the average jobbing foundry is confronted with the constant changes which must be made to suit different patterns. Probably this accounts for the large number of wooden flasks in use by shops having no specialty of their own. In a contribution to the *American Machinist* Mr. R. H. Palmer takes up the subject of building iron flasks so that they may be readily altered to conform to patterns of nearly uniform size but of different style.

Fig. 1 shows an iron flask bolted together at the corners, the sides are about ⅝ inch thick, with flanges or ribs on each of the sides; these ribs are set back from the edge about ⅛ inch, while there are four rows of holes and trunnions. The ends are plain, with flanges at each of their ends to bolt the sides against. The holes in the sides not used for bolt holes to fasten in bars, form vent holes, and by

having them in lines the bars may be placed to meet the requirements of the pattern.

It will be seen that the end is left with a large, round opening, as there have been pipes made in it. Bolt holes *B* also are seen; should occasion require, a plate made in open sand with holes in it can be cast and bolted against the ends of each half to close the hole. The flask sides are drilled for pin holes in the ribs *C*, so that these parts may be used to make a three-parted flask, or as many parts as needed. In leaving the rib back from the edge a fraction of an inch it forms a chipping piece around the edge so that it can be easily

say, 18 or 24 inches deep, instead of making the nowel or drag the full depth required, divide the depth in at least two or three sections. I have many times found it better in cases where a deep nowel was required to make it in sections, say, 8 or 9 inches in depth, or 8 and 12 inches, having holes bored so that the bolts holding it together could be removed and the same holes used as pin holes when by casting a new set of bars, the original deep flask can be rebuilt into a number of shallow flasks.

In every jobbing foundry there is a certain run of work which seems natural to that foun-

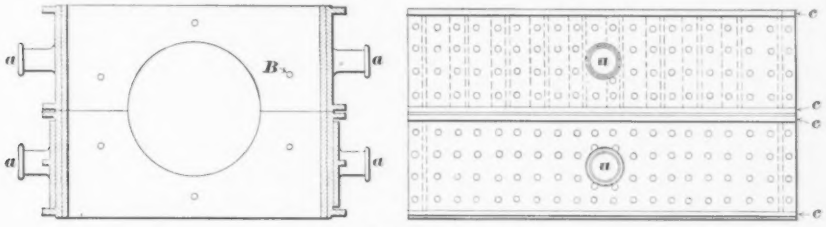


Fig. 1

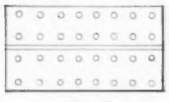


Fig. 2

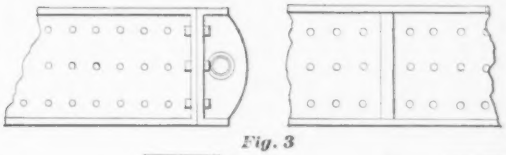


Fig. 3

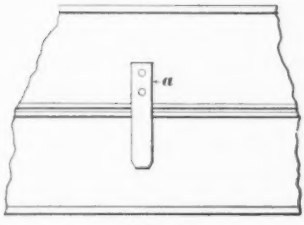


Fig. 4

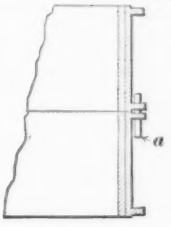


Fig. 5

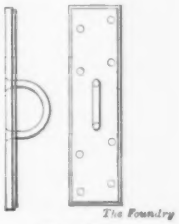


Fig. 6

COMBINATION IRON FLASKS.

fitted in case there is any rocking of one part on another. The bars in the cope are cast with a part of the circle cut out for pipe; by coring a few holes in these bars, chucks are easily bolted in as required. As these holes are ½ inch, a number of spikes easily fill them and a wooden bar can be fastened in.

Fig. 2 shows a piece cast with holes to match those in the side of the flask. If a flask is required longer, take out the end of one, butt it against a second, and use piece, Fig. 2, to tighten together; take short bolts out of the bars and use longer ones.

In making flasks which are wanted to be, dry and requires flasks of certain sizes, but varying principally in depth. A flask may be quite long and perhaps of slender build apparently, yet easily handled if arrangements are made to hitch on to it so as to properly balance it when hoisting with a crane.

In casting trunnions on a flask I have them made in a core, and set the core where I wish a trunnion, and ram it up in the mold.

On the larger flasks of iron an arrangement, Fig. 3, combining a staple to hitch into when rolling over a heavy cope, may be found very useful. In making it a rib is added on the pattern with a core print.

Flasks of different lengths and widths of the above style will be found very convenient. We have them from 30x36 inches up, and in the style here shown. If a smaller flask is required for green sand, drop a piece of board in the ends to close up.

In regard to pins for iron flasks, a foundry usually finds them quite expensive, even if a machine shop is a part of the concern. I have tried coring some holes in the side of the cope and casting a cast-iron guide *a*, Fig. 4, and bolting it to the cope. If one is broken it is easily replaced. I like cast iron better than wrought, which gets bent unless very heavy. If cast iron is used and gets broken (which I have not had happen), it is easily replaced.

Another style of pin is shown in Fig. 5. The same sized hole is bored in the cope and nowel flanges. The pin is tapered but very little for three-quarters of its length, and near the smaller end it is tapered more. The larger end is simply too large to drop through the hole. I find the pin works very nicely and is very cheap. I had one turned out of wood and gave it to the molder, who cast it on end. We rattle them and they are ready for use.

If the flask requires a long steady pin, we have a set of these made of common round iron, with one end an inch or so bent square and the other drawn out a little, but not to a sharp point. We drop these pins through the holes in the top flange of the cope, passing down through the hole in the lower flange of the cope and through the hole in the top flange of the nowel, and we have them as long as we wish. In some flasks we use 5/8-inch round and some 3/4-inch, the holes being bored large enough for the round iron to pass through easily.

In making iron flasks they can be made quite light if well ribbed on the sides, but there is a limit either way. One often sees castings strained because the flask is not stiff enough to withstand the side strain, and the man making it does not realize the amount of strain on his flask and does not provide side binders, or top and bottom binders when there are lifting strains.

In providing for the handling of large flasks, I have been in the habit of casting a piece like Fig. 6, making these of different lengths and sizes so that they can be changed from one flask to another, and bolted to the sides of cope and nowel. In hooking into them and rolling over a large cope, it is better to wedge or block around the hook, but the size of the staple is regulated by the sizes of hooks on chains. Often a piece of rag wound around the staple will do the business, but the safest way is never too safe. I have the staple upset on the ends, have a rough pattern made the size I wish, burn out the holes for bolts with an iron, also the holes for the staple, set the staple in the pattern and mold. I had some cast with the staple just nicked, instead of upset, to keep from pulling out, but as the nicking was done too deeply the staple broke and it came near being a bad accident while rolling over; so I had rather have them upset.

In general, where light crane flasks are used, iron ends will be found very serviceable. Once in a while you will find a molder who will not look at his cope to see if the bolts are tight, and who will cuss the flask because he neglected to do so and because the flask cannot keep itself in order, but he is usually one of those men who find that others are to blame for their own carelessness, not themselves.

Considerable changing about can be done with iron ends as well as wooden. I have a flask in use in the foundry which was made from an old lathe-bed flask. It is fastened together by bolts extending from side to side outside the ends. The cheek was originally altered to 6 feet 6 inches square by 25 inches deep and a tank was swept up in green sand in it, 5 feet 10 inches in diameter by 25 inches deep. It was then unbolted and packed away. Later the sides were used, ends were put in and a pipe 15 inches in diameter was swept, this part being barred up for a cope. It has now been taken apart again, the ends as used for the tank have been replaced, and a ring is made in it. I have flasks made in the same way where the ends are not gained into the sides, simply butted against them, and where the ends have been moved back and forth according to the size of the piece to be cast.

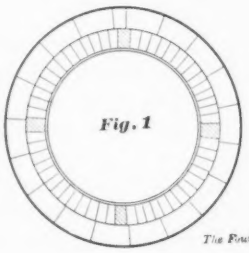
Cupola Linings.

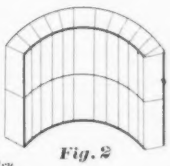
Complaints are often heard in regard to the life of cupola linings and much speculation is indulged in as to the cause of their failure to stand up under service. Writing in the *Mechanical World*, Walter J. May refers to this part of British cupola practice as follows:

In working a cupola for melting iron, the

lining is of much importance in securing the best results, and only too often is it found in a bad state, the result being that there is a loss of efficiency. As to who should bear the blame for this is an open question, because if we have an efficient cupola attendant and he has not time or material at his command, then he is not to blame; while on the other hand, if we engage an inefficient man, say the first yard labourer in want of a job, and provide all requisite materials and time, and yet do not instruct him as to what to do, it would appear to most persons that again the man is not to blame. Provided a cupola attendant knows his work and is provided with materials for working, as a rule he will keep the furnace properly fettled and in a condition to perform its duties in the most efficient manner in accordance with its design; but if he does not—well, change your man for another at short notice.

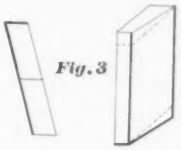
The majority of cupolas are regularly-formed cylinders when first lined, but in time they get out of shape unless care is taken. The heat will not be kept in the place where it is most wanted, the result being that sluggish metal will be produced, and probably an excess of sulphur will get into it as well, owing to the charges balling up somewhat instead of melting regularly in the melting zone or point of greatest heat, a position which in most cupolas is just above the tuyeres. Naturally, from the hearth to the top of the melting zone the cupola linings suffer most, and from the top of the melting zone the lining becomes less damaged by the heat, the

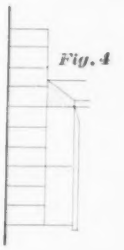


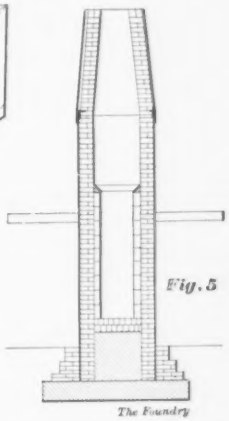


upper portions suffering more from abrasion than fire, and particularly is this the case where wide joints are allowed between the bricks or blocks used in the lining. In fact, in all fire brick work it is usually the edges of the bricks that first fail, and in regard to this trouble often arises.

Now taking the ordinary brick-lined cupola, a lining of bricks laid flat is usually adopted. In front of these, as high as the charge extends, another ring should be placed, this being composed of arch bricks set on end, the arrangement being as shown in Fig. 1. Proper blocks can be used for the outer course, and this shows advantages over bricks, as the number of joints are fewer; but even







with these the inner shell is desirable, as this can be renewed as often as required. Arch bricks by thmselves are hard to get out, however, and in accordance with the size of the ring, from two to six plain fire brick courses, vertical, should be inserted, as these are easily pulled out when necessary, and repairs and renewals can easily be made. This arrangement is shown in Fig. 2, and further explanation is unnecessary.

Where the well of the cupola is required to be conical, the bricks used will have to be cut and rubbed into shape. And assuming we are about to form this part of the furnace with, say, a top diameter of 3 feet and a bottom diameter of 2 feet, with three courses of bricks in height, it will be found necessary to cut the bricks as shown in Fig. 3, unless we have blocks specially made. The advantage or otherwise of this arrangement of well is open to discussion, as some prefer it, while others think that it is not at all necessary or desirable. The writer, however, does not wish to express an opinion. Still, in some cases, coning is used, and at times very badly, as after the front edges of the bricks are burnt away, metal finds an entrance and either burns or displaces the lining. In any case, where such work is done, there should be the greatest care taken that the work is absolutely

sound and of the very best, both as to material and workmanship.

The tuyère openings should be cast-iron blocks, and these should project about half an inch beyond the face of the brick lining inside. These blocks are not likely to melt with the ordinary cold blast supplied to a cupola, and they save the lining considerably. Iron blocks should be of such a size as to work into the brickwork in the same way as a block of bricks would, and they should be shaped to work properly into the ring of brickwork.

A cast-iron ring is also desirable at the top of the inside ring of brickwork, and should for convenience be in two or three parts. This arrangement is shown in section in Fig. 4, and, as will be seen, the ring prevents the undue wear of the edges of the bricks when the charges are thrown in.

As to the material used between the bricks, perhaps finely ground, thoroughly soaked fire clay would prove most convenient, Stourbridge being preferable to Newcastle clay. The thinnest possible joints should be made, and the back of each ring between the iron shell and the bricks should be grouted in with clay and water. For the inner ring, which has to resist the greatest heat, ganister, very finely ground as for steel furnace work, should be used, and this works as well as fire clay with a little care, while it is not disposed to let the joints become damaged by heat. The ganister probably would be more expensive than fire clay; but as this is the best facing for the brickwork after erection, and as it is very durable for ladle linings, it pays to have a truck-load in the first place when erecting or relining a cupola, as there need be no waste with it.

The height to which the fire bricks will be necessary will not be above the shell of the cupola, anything above this being done in good ordinary bricks and mortar, unless flues of any kind have to be made, and with these only the throating need be in fire brick, unless fire bricks are practically the same price as building bricks, when, of course, the more refractory material should be used.

After the brickwork is done, at least a week should be allowed for it to dry somewhat, and then a small gas-coke fire may be started and kept going for another week to get the work thoroughly dry, while after this the furnace may be prepared for melting. Before melting is done, however, it is well to add a protective lining of ground ganister reduced to the consistency of putty and well kneaded by treading to make it tough, having this lining about ½-inch thick above the melting zone, and from thence downwards about 1 inch thick, well beating it onto the face of the brickwork. This costs little, and very considerably improves the durability of the furnace.

In making repairs, by cutting out the ordinary bricks the arch bricks can be taken out and replacements made where necessary; but in no case should more than the inner lining have to be dealt with in this way, and even this not often, as after each blow the inside of the furnace should be cleared from slag and dressed with ganister where necessary. Where a cupola is used every day for a considerable time it becomes a most unpleasant job to get inside it for repairing the ganister lining, and there is no reason to wonder at neglect in regard to fettling, it often happening that only on Sunday or Monday morning is the furnace really fit to enter. Where the work is so heavy it is well to have a second cupola, and work one while the other is being fettled. Where a range of several cupolas is being worked, one should always be off for repairs, as it is not relining that is so necessary as the prevention of this operation by renewing small defects as they occur.

The amount of brickwork will depend very much on the form of cupola, but in any case the whole of the shell should be lined from the hearth upwards, and in some cases a domed chimney can be used with much advantage for some 10 feet or more above the shell. This, however, depends on the make of cupola used, and in some cases is not necessary; but as a general rule the higher the cupola and chimney within reason the better the melting.

In Fig. 5 a cupola is shown in section in which the writer melted both iron and high-carbon steel—files, tool steel and the like, and spring steel,—not as an experimental matter, but as a regular practice, both being brought down as fluid as oil. The internal diameter was 18 inches and steel came down at an average rate of a ton an hour, and iron at the rate of seven tons per two hours. Brancepeth coke was used at the rate of 25 pounds per hundredweight of steel, and 7 pounds per hundredweight of iron, but with slower melting

with iron 4 pounds per hundredweight was enough. Owing to the awkward shape of such things as files, they had to be put into the furnace so as to descend vertically, and only 1 cwt. could be safely charged at a time; but with iron the charges varied from 3 cwt. of hematite pig to 5 cwt. of light scrap, according to what was being melted, and in this discretion had to be used. A good blast was always maintained, and necessarily this had much to do with the melting; and when steel was being dealt with in the summer, the lad who was charging had a hot job, an overcoat being unnecessary. The well being only about 14 inches deep, slag was taken off continuously, chalk or glass being used whenever it became necessary to render the slag fluid—a necessity which did not often arise. The air was supplied through two 4-inch tuyères, which were opposite each other at different levels, and a Sturtevant pressure blower was used, this being at some distance from the cupola, the air pipes, which passed underground, being of 12-inch glazed drain pipes.

It is true the cupola was an old-fashioned one, but as it was both economical and efficient for the purpose for which it was required, that was sufficient, and as certain restrictions as to height and design had to be met to conform to the wishes of the district surveyor, and to obtain the license of the London County Council, the best use of the arrangement was made. Probably, however, this form of cupola is not the best for general work, and certainly the writer prefers the use of a receiver when mixed irons are used, as a more even result can be obtained with a better mixing of the metal.

Fine ground, highly refractory ganister has been mentioned for lining purposes more particularly as it is easily obtained from Sheffield and elsewhere, and because it answers well for iron melting; but there is no reason why a more refractory material should not be used, so long as it will stand against the abrading action of the descending charges. The same remarks apply to bricks, and magnesite or other highly refractory goods can be used where the heat is most intense; but whether such would be profitable depends on a variety of circumstances which need not be entered into.

The Acme Foundry Co., Detroit, recently incorporated, expects to build at an early date.

Interesting Features of Modern Foundries.*

The matter of making castings for modern machinery is one that has but recently received due consideration, there having apparently been less study put into this department than in almost any other in machinery building. The general jobbing foundry of New England is in rather a sad state, for which we consider the machinery manufacturer who buys his castings from jobbing foundries is very largely to blame. He forces a very low price and gets a remarkably low grade casting in consequence, yet, in light machinery work especially, the first cost of a number one casting should be considered of secondary importance where very much machining is required. The cotton and woolen machinery concerns and such people as the Brown & Sharpe Mfg. Co., and Walker & Pratt Mfg. Co., make strictly first class castings. To this class, also, belong the Draper Co., Saco & Pettee Machine Co., Howard & Bullough, and the Mason Machine Co. These people today are resorting to the use of molding machines extensively, with very satisfactory results, obtaining difficult castings with unskilled help. By the use of machines, many of our foundries have been able to bring the molders' union to agree to a fair adjustment of wages, and its value is generally recognized in this direction. One of the most novel foundries to my knowledge is that of the Crane Co., Chicago, who make pipe fittings, valves, etc. They have their cupola and charging floors on the sixth story and all supplies are stored in the basement and elevated to the floor. The castings when poured are placed on a carrier, which takes them to the floor below, where they are cleaned and passed along to the machine shop; when they reach the bottom floor, they are completely finished and ready to be shipped or go into stock. We found here a record of 110 men producing 65 tons of castings a day on miscellaneous pipe fittings, from ⅛-inch elbows up. This foundry required little or no space for molding machine floors, the sand being automatically mixed and conveyed to the machines. The molding machines and molders occupy practically the whole foundry area, having only sufficient room for each molder to turn round and place his own half of the mold on an endless overhead carrier, with depending platform. Each mold was closed by a laborer,

*From a paper read by S. D. Leland before the New England Foundrymen's Association.

bound, weighted and poured while the molds were in motion. On arriving at the dumping point these molds were slipped into an endless conveyer, which took them up to the level of the cupola floor, where they were shaken out and the sand and castings distributed to the proper places. The McCormick Harvesting Machine Co. has a foundry on this plan, as has also the Milwaukee Harvester Co. This last, I think in many respects, is a model for light machinery foundries in this country. It is two stories in height, with the molding floor on the upper one, the basement being used largely for storage of castings and general foundry supplies. The Westinghouse Air Brake Co. have an arrangement more or less similar to that of the Crane Co. Their endless moving platform passes along on track and wheels and they do substantially what the Crane people do in closing and pouring the molds while in motion, and in mixing and conveying their sand by machinery.

The class of work done by the Mesta Machine Co., West Homestead, Pa., is extremely heavy. This foundry is equipped with two 15-ton air furnaces, two 18-ton and two 30-ton air furnaces. All iron used in making rolls or particular castings is melted in this style of furnace. These air furnaces are located so that the rear end of the furnace comes in the outer wall of the building. The stock yard is located alongside of the foundry and is served by a 15-ton traveling crane. This crane is so designed that it can be used for charging the air furnaces. A large percentage of the castings made by this company are molded in some sort of pit in the ground. The general construction of these pits is of cast iron sides and ends; the sides having a series of strips, cast vertically on same for the purpose of retaining a parting wall; this parting wall being slid into place in different locations to determine the size of the pit. This, I was told, they found very useful and at the same time economical, as it saved constantly digging new pits and walling up the same.

A novel feature was seen at D. M. Osborne & Co.'s plant, at Auburn, N. Y., in connection with air furnaces. Buggy ladles are used for serving the iron to the molding floors. To facilitate the use of these buggy ladles they have a cast iron walk, about 4 feet wide, with flanges cast on each side 1½ inches high; these plates are cast in sections about 4 feet long, and are used to make parallel walks lengthwise through the foundry as well as crosswise in the aisles. The rest of the foundry, other than these iron walks, is a sand floor. The flanges are to prevent the buggy ladles from running off the walks.

On the cupola they have a specially constructed spout as well as a tilting receiver. The object of this combination is to not plug the outlet whatever, but to have the iron flow continuously from the time they start to melt. In this specially constructed spout, close to the body of the cupola, they have a trap, in the top of which there is a groove from which the slag runs away. The melted iron passes through the trap, or under the same, and out through the spout in the regular way. At the end of this spout they have, mounted on trunnion bearings, a tilted spout with a deep pocket in the center of same for the purpose of preventing the flowing iron from cutting out the bottom which is tilted so that one end is at an angle of about 30 degrees, the other end of the spout being elevated. The iron flows through this tilted spout into the ladle and when this is filled there is an empty one on the other side when the spout is tilted in the opposite direction, thereby turning the course of the melted iron into the empty spout. The spout is constructed in the shape of a V, with a flange projecting inwardly on each upper edge, so that a fire brick just fitted into the spout endwise. This we were informed was an advantage and a more economical way of lining the spout than by using plastic fire clay, as the life of the fire brick was much longer and it saved the bother of patching up every day, as the case would be if fire clay were used. This whole equipment seemed to be working very nicely and appeared to be a labor-saving device.

The McCormick Reaper Works, at Chicago, have a foundry in operation similar to that of the Crane Co., and they are able to get some remarkable outputs in their molding machine work. These people make mowing machine frames. Of these frames, containing 27 cores, 150 are produced in a day by eight men. One man devotes his time to setting cores and patching break downs; but very little of this work was seen. Four men were employed in hand ramming and the rest in taking the molds away and placing the flasks on the machine. It was one of the best regulated molding jobs seen, producing such a heavy output.

At the new Sturtevant foundry in Hyde Park, Mass., a novel feature of conveying the stock to the charging room was noted. The

stock bins containing coke, iron, etc., are located in one side of the foundry in line with the cupola. The iron and coke are loaded on a car, passed over a scale, weighed, and run onto an elevator up to the charging floor. Nothing is stored on the charging floor other than a fan blower used in connection with the cupola. Two men are stationed there who take the car from the elevator, which is located in close proximity to the cupola, unload the same, when the car passes down an incline, thereby gaining momentum sufficient to carry it along over the top of the stock bins onto an elevator wholly by gravity. When the car passes onto the elevator and reaches the back side of same, it comes in contact with a switch, which sets the elevator in motion. The elevator lowers on a level with the ground floor, when the car is returned to its proper place for refilling.

Resignation of Martin Fox as President of the Iron Molders' Union.

The possibility that the condition of his health might compel Martin Fox to resign the presidency of the Iron Molders' Union of North America, has been discussed for the past two years. Recently, it is understood, Mr. Fox formally presented his resignation to the executive board of the union and it will take effect at an early date. This action was taken in the face of strong urging from his associates to continue, added to assurances that such help as he might need would be provided, to relieve him of the brunt of the president's burdens. For a time Mr. Fox will assist in the care of a number of matters now pressing upon the attention of his official associates. His successor will be Joseph F. Valentine, who has been his able lieutenant for a number of years. M. J. Keough will become first vice president; John Campbell, second vice president; Geo. Custer, third vice president, and Mr. O'Leary, president of the coremakers' union before it amalgamated with the Iron Molders' Union, fourth vice president.

Martin Fox was born in Cincinnati about 55 years ago. He served an apprenticeship to iron molding in Resor's foundry and worked continuously at that trade until he became officially connected with the Iron Molders' Union of North America. In 1880 P. F. Fitzpatrick, president of the union, appointed Mr. Fox as his clerk and in 1886 the union created the office of secretary, electing Mr. Fox to fill the position. On Mr. Fitzpatrick's retirement in 1890, the Detroit convention of the Iron Molders' Union made Martin Fox its official head.

One of the first acts of Mr. Fox as president was to enter into negotiations with the Stove Founders' National Defense Association with a view to ending the conflicts between the organized iron molders and the stove manufacturers, which had sadly handicapped the stove manufacturing industry during the eighties. In these efforts he had the hearty co-operation of Henry Cribben, then president

MARTIN FOX.

of the defense association, with the result that in 1891 the foundation of what are now known as the conference agreements was laid at a meeting of representatives of the two organizations in Chicago. Under this arrangement there must be neither a strike nor a lockout until investigation has been made by impartial representatives of both associations.

Conciliation, as applied to industrial disputes, was not so much talked of in 1891 as it is today and in its advocacy Mr. Fox had to face the bitter opposition and harsh criticism of many members of his union. But, despite all opposition, he succeeded in bringing about the ratification of what is conceded to be the first undertaking in the United States between associated manufacturers and organ-

ized workmen, whereby both parties were pledged to arbitrate their differences.

In 1895, 1899 and 1902 he was successively re-elected to the presidency of the Iron Molders' Union. During these years he not only piloted it through one of the most trying periods of its history and made it one of the most substantial trade unions in the country, but won for himself and his organization the respect of American foundrymen. Shortly after the organization of the National Founders' Association Mr. Fox made advances to the representatives of that association with a view to still further applying the principles of peace and conciliation. The New York agreement of 1899 was the result. Not only on the question of arbitration of disputes did Mr. Fox take advanced ground, but his attitude upon the molding machine question, apprentice ratio and other vital issues marked him as an advanced thinker in the labor world, and, though conservative in many respects, progressive and broad-minded when considering the problems which confront American industries.

Mr. Fox is well known among the foundrymen of the United States and Canada and is held in very high esteem by all who have met or had any dealings with him. Fidelity to principle and to obligation, firmness and a high sense of justice have marked his official career. His name is generally regarded as a symbol of good faith and fairness and it may well be said that the whole foundry industry will regret the necessity of his premature retirement from active leadership.

How to Determine the Quality of Pig Iron.*

BY S. B. PATTERSON.

We must realize not only the great number of metals and metalloids to be found in iron, but that these combine with each other as well as with the iron; that the new compounds thus formed have characteristics differing from those of either component, and that the influence of an element may be increased, lessened, or neutralized in the presence of another. The authors of formulas specifying for each kind of casting the amount there should be of graphite and combined carbon, silicon, manganese and phosphorus between certain limits, with an upper limit to sulphur, make the maximum and minimum so far apart (a wise precaution) as to make their rules too broad to be of much, if any, value One will consider only the ratio of the graphitic to the combined carbon, accepting iron with almost any silicon per cent the furnacemen may send. Then we have a class whose fad is the silicon contents only, and I have known of a few cases where manganese was considered the sole mainstay of good castings.

CARBON AND SILICON THE MAIN STAYS.

Let us now consider those influences exerted by the ordinary elements to be found in pig iron which are generally accepted as established. I consider that carbon and silicon are the essential constituents of foundry pig iron. The remaining ordinary elements are manganese, sulphur, phosphorus and titanium. At times, and in small quantities, are found portions of all of the following: Copper, arsenic, calcium, magnesium, vanadium and occasional other rare metals. Carbon in pig iron occurs in two forms, in the graphitic and in the combined state. In the former case it is mechanically mixed. All the other elements of our alloy are chemically combined. Some scientists claim that there are other forms of carbon in iron, but as the matter is still in the cloudy realms of speculation, we will not consider them. Carbon makes pig iron fluid, thus differentiating it from wrought iron. When graphitic, it conduces to soft castings. When combined it makes them hard. The fracture of pig iron is a crude indication of the ratio of the graphitic to the combined carbon. No. 2 X and No. 2 plain iron having nearly all the carbon in the graphitic state; gray forge has less graphite and more combined carbon, and so on down the grades until we reach pure white iron in which the carbon is practically all combined. Therefore, the fracture is a sufficiently close guide in selecting ordinary pig iron as to the relative contents of the two forms of carbon Silver gray iron has an appearance of its own too familiar to need description and is outside the category of ordinary pig iron when it comes to the appearance of its fracture. To show one of the misconceptions of the past, such iron was called carbonized, or burnt iron, in my youthful days, while we know now that it is a siliconized iron. Now it commands a premium; then it was almost unsalable. The amount of total carbon in pig iron is fairly constant, being generally within the limits of 3¼ and 4 per cent.

Silicon and carbon, as before stated, give

*Read before the New England Foundrymen's Association.

foundry iron its essential characteristics. Were the remaining elements absent these characteristics would still be preserved. The effect of silicon in itself is to make iron hard, and yet it serves admirably to make soft castings. I believe a correct explanation of this seeming paradox to be as follows: On melting pig iron, and on remelting cast iron, there is a marked tendency in the graphitic carbon to go into the combined state, the amount so changing being dependent on certain conditions. This increase of the combined carbon increases the hardness of the casting. Silicon diminishes this tendency of carbon to change its condition, thus keeping the graphite more nearly to its original proportion, and therefore preserving the quality of softness. The scientific statement is that silicon diminishes the solvent power of molten iron for carbon. I presume another way to put it is that combined carbon produces a greater degree of hardness than an equal amount of silicon, and the silicon having the greater affinity for the iron prevents an equivalent amount of carbon going into combination with it. Silicon thus secures softness by preventing the formation of the more efficient hardening agent, combined carbon. Having a sufficiency of silicon to produce a soft casting, any excess causes hardness.

The claim has been made for many years that silicon produces graphitic carbon, i. e., causes carbon on the remelting of iron to pass from the combined to the graphitic condition, and cases have been instanced where good castings have been made from all scrap iron or from very inferior grades of pig by the use of high silicon compounds. But if such be the fact, does it not seem strange that intelligent foundrymen continue buying the higher-priced foundry grades when cheap mottled and white irons would do as well? I am sure there are other iron masters than your humble servant who would like to see openings for these off grades other than the furnace top.

The action of the blast in the cupola oxidizes a small portion of the carbon and of the silicon. Per contra, the iron absorbs carbon from the fuel, sometimes sufficient to more than offset the loss by oxidation. Not so with silicon, which diminishes at every melting.

THE EFFECT OF MANGANESE.

Manganese is a beneficial element in pig iron to a certain limit, serving two functions. It eliminates some sulphur, whether the sulphur is inherent in the iron, or absorbed from the fuel during melting. It also acts as a bulwark to the silicon, diminishing the amount of wastage during melting. The explanation is that manganese, like silicon, oxidizes at the temperature of melting iron, thus dividing the action of the blast in the cupola.

The invention, or more properly the discovery, of the pneumatic process of making steel gave a wonderful impetus to metallurgical chemistry. As an epoch-making event it ranks in the industrial world with the discovery of America by Columbus in history. In the manufacture of iron and steel it led mankind from the dusk of empiricism to the light of scientific knowledge. Let us refer to the Bessemer process for enlightment on our subject. It is known that blowing air through molten iron in the Bessemer converter immediately starts the oxidation of the manganese, which is followed very closely by the burning out of the silicon, both elements being soon eliminated. At the end of this first period, which lasts from eight to ten minutes, the temperature not having been sufficiently high, no diminution of the total carbon takes place, but there is found to be an almost complete conversion of the carbon from the graphitic to the combined state. Please note that this change takes place immediately after the disappearance of the silicon, which fact seems to me to be proof in a negative form of my previous statement of the function of silicon in maintaining carbon in the graphitic form.

The action of the blast eliminates the manganese and silicon at a temperature slightly above the melting point of iron. Carbon, however, is not oxidized to any appreciable extent at this temperature, requiring a much greater intensity of heat to effect its removal. This necessary degree of heat is produced by the rapid combustion of the silicon and manganese, and the disappearance of the carbon therefore follows as a sequence of their elimination. We do not, however, obtain any such increase of temperature in the cupola, because the air is blown over the molten metal and not through it, as in the converter, and the carbon therefore is not consumed to any marked extent. In the latter case the action is superficial, the oxidation being slight and incidental, while in the other it is fundamental and complete.

I know of a brand of iron wherein the manganese content was so small as to be a negligible quantity; nevertheless, the iron was used successfully for about every species of casting from stove plate and light bench hardware work at one end of the gamut, to water pipe

and engine cylinders at the other. The iron was selected in each instance with more silicon than would have been done with irons containing the ordinary per cent of manganese. This brand was noted for its low sulphur. Owing to the absence of manganese, however, it was the more incumbent on the foundryman than usual to use a low sulphur fuel for melting it.

Manganese, like silicon, when in excess causes hardness. This fact is shown in the alloys spiegeleisen and ferro-manganese, both of which are characterized by extreme hardness. The former contains 10 to 30 per cent and the latter often reaches 80 per cent manganese.

PHOSPHORUS AND SULPHUR.

Not much need be said as to phosphorus, as its influence is well understood. It makes iron fluid, so that it flows readily into every intricacy of the mold, taking the most delicate impressions. It, also, reduces shrinkage. As it causes weakness and brittleness the amount must be kept within bounds. For malleable castings, however, but little phosphorus can be permitted, the limit being slightly above that for Bessemer iron.

Sulphur still remains as a bete noir to vex the metallurgical mind. It is the rod of affliction to many a poor iron master. It does not seem to have a redeeming quality. In iron it causes hardness, blow holes, weakness and shrinkage. It generally occurs as a sulphide of iron, but not infrequently forms a compound with titanium, and probably with some of the rarer metals which are occasionally found in iron. I particularly call attention to this fact for the reason that the determination of sulphur is generally made in furnace laboratories by the evolution method, which has a popularity owing to the speed and ease with which it is accomplished. It fails, however, to give that portion of the sulphur which is combined with titanium.

It is probable that titanium sulphide is innocuous in pig iron, but I am not aware that this matter has ever been determined.

While on the subject of sulphur I will refer to a prevailing theory which I believe to be erroneous. I alluded to it when discussing the influence of silicon. It is that silicon in the cupola increases graphitic carbon by driving some of the combined carbon into the graphitic form; and, also, that the grayness of cast iron in the blast furnace depends upon the amount of silicon present

DECEPTIVE APPEARANCES.

I have made hundreds of tons of iron, the fracture showing a very coarse grain, and a very dark color, sufficiently so to grade it as No. 1 or No. 2X, but in which the silicon contents were less than 1 per cent, sometimes even running below .75 per cent. More than one foundry customer have eagerly picked out such iron as being just what they wanted, and were astonished when informed that it would make castings so hard that they could not be drilled. The iron was made for puddling at a rolling mill, where very high grade wrought iron was a specialty. Per contra, the same blast furnace with the same materials produced irons gray forge in fracture but with more than 3 per cent silicon, and at times even a decided mottled iron with more than 2 per cent silicon. Here we have two instances of the exact reverse of the theory: viz., high graphitic carbon with low silicon and low graphitic carbon with high silicon. Now our analyses showed sulphur down to a mere trace in the low silicon 2X iron, and an amount above normal in the high silicon forge and mottled, so that sulphur would seem to be a factor to be considered.

These low grade irons were not produced intentionally, but the furnace made them in spite of our efforts to the contrary. It always happened in very hot weather, and when the atmosphere was surcharged with moisture, with a light burden on the furnace, which light burden was carried (but in vain) to secure a better grade of iron. I offer with hesitation the following off-hand explanation of this phenomenon, and as a preliminary to a clear understanding will briefly outline the theory of the blast furnace operation. The action of the gases removes the oxygen of the ore, producing a nearly pure iron, which makes its appearance in a porous or spongy condition just above the zone of fusion. So far we are in the realm of established fact. This iron sponge now absorbs carbon, silicon and other elements going to make pig iron, but as to the exact modus operandi and as to the exact place, and the exact order of these final processes we can only speculate. With such a multitude of variable and changing conditions, such as the relative proportions, kinds and qualities of materials, speed of operation, temperature and quantity of air blown, and the condition of the atmosphere, it is highly probable the sequence of the absorption of the various elements and the intensity of the various actions are subject to con-

tinual change. The discordant results often obtained from a blast furnace can only be explained on such hypothesis.

It takes somewhere about 200,000 cubic feet of air to make a ton of pig iron. The amount of water carried into a furnace on a hot muggy day must therefore be no inconsiderable quantity. A gentleman who operated a small furnace told me that he had made calculations showing that the weight of water driven in on some such extreme day, was greater than the tonnage of iron made. The decomposition of this water must very materially reduce the temperature of the furnace hearth, which means low graphite and high combined carbon, and also high sulphur. But with the furnace carrying a very light burden the higher zone may be very hot, so that we can imagine the reduction of the silica taking place in such upper hot zone, and the absorption of the silicon by the iron sponge. This sponge now impregnated with carbon and silicon descends into the zone of fusion, the temperature of which and of the hearth beneath is below normal, for the reason just given. In consequence of this comparatively low temperature a lesser portion of the carbon becomes graphitic, and the iron absorbs, or perhaps we may more correctly say retains, more sulphur than it would have done with a hotter furnace hearth. To my mind the ratio between the graphitic and combined carbon is not so much a function of the silicon, as of the temperature of the furnace hearth.

INFLUENCE OF TITANIUM.

Titanium, the last named of the ordinary elements of our alloy, is one about whose influence there is much misconception. In my business experience I have had instances and and have heard of them where bad castings were attributed to titanium in pig iron. But I do not know of a single authenticated case which showed such claim to have any foundation. The real victim of this element is the furnace manager, not the foundryman.

Titanic acid occurs in almost every iron ore, and it impregnates some magnetites to such an extent as to render them valueless, in the present state of our art. There are many million tons of such ores in the Adirondacks. Most of the titanic acid goes into the furnace slag, and being very difficult of fusion, a sticky cinder results which obstructs the tuyere openings, and, being cumulative, gradually builds up the crucible. Our experience with titaniferous ores has been in the past, when blast temperatures were very much lower than now. Then ores were rarely judged by chemical analyses, and consequently titanic acid would only be discovered by its injurious effects on the working of the furnace.

I remember hearing of the experience of one of the old-fashioned furnace founders in the days when those functionaries went about their duties with closed mouths and wise looks, and who were supposed to be the custodians of certain maxims too profound and too valuable to be imparted to their fellowmen. Owing to the closing up of his furnace hearth, recourse was had by the furnace owners to a chemical examination of the materials used, when it was found that one ore contained a large per cent of titanic acid. By leaving off this ore the furnace was saved, but always after that our metallurgical Solomon was certain that any bad working of the furnace was due to some more of that "d—— botanic acid."

It is possible, with our high blast temperatures and consequent hot furnace hearths, that the slag from ores containing a moderate amount of titanic acid could be rendered sufficiently fluid to flow through the cinder notch; but while the supply of ores free from this substance is abundant, no one seems sufficiently interested to try the experiment. But very little titanium goes into the iron, and I have never seen any proof that this little produced an injurious effect. On the contrary I do believe it imparts strength. Prof. Porter W. Shimer states that he has always found some titanium in pig iron, the range of his analysis showing it from .05 to .40 per cent.

THE SELECTION OF IRONS.

Open-hearth and Bessemer steel mills can only be operated with aid of the laboratory, and they necessarily purchase their pig iron on full and explicit chemical specifications. Requisitions of such kind are welcomed by the progressive furnaceman. But there are many foundries not in a position to operate a laboratory. By what simple rules can they be guided in selecting their irons? Most blast furnaces are run on pretty constant and uniform assortments of raw materials, when making any one particular kind of iron, be it foundry, mill, or basic open-hearth. Under such uniform conditions the phosphorus is bound to be constant, as all that is in the raw materials goes into the pig iron. The manganese will vary more, as some goes into the iron and some into the slag, but the variation will not be sufficient to affect the castings. Silicon and sulphur are the variable elements, the

former to the greater extent. For this reason all furnace companies do, or should, analyze each cast for these elements. Now let the foundryman ascertain the usual per cents of phosphorus and manganese to be expected in the iron he purchases. Should these be changed at any time by a change in the raw materials, the furnaceman should inform his customer. The fracture shows the ratio of the graphitic to combined carbon sufficiently near for all practical purposes. Finally, with the silicon and sulphur contents given, the foundryman has all necessary data to make a start. Owing to the endless variety of sizes and shapes of patterns, and the very many qualities sought for in castings, some experimenting will be necessary before obtaining the end desired. By getting his data and working out his conclusions in advance of operations, he will be able more quickly, economically and satisfactorily to reach his goal than by any hit-or-miss method.

I am inclined to think that the smaller foundries often use too many kinds of iron. The disadvantage in so doing is that in the event of the need of checking up the analyses of the pig irons, the time required and expense incurred are thereby increased as well as the difficulty of locating the trouble. It is seldom necessary to go beyond two brands to get a desirable mixture.

The pig iron manufacturer gets no guarantee as to furnace results from the purveyors of his raw materials. He ascertains the analyses of his fuels, of his iron ores and their physical condition and the analyses of his flux. With these data, and with a knowledge of his conditions of manufacture he must deduce the proper mixture for his furnace, and the proper way to run it. So with the foundryman. A conscientious furnaceman will furnish an honest analysis of his pig iron. If he is a wise man he will not assume the ability to advise his customer, how to select, how to mix, and how to melt his iron to get specified results. He should decline such a task, knowing full well that the man who operates the foundry cannot do it successfully on the judgment of another. The foundryman is on the ground, he has all the data, and it is up to him to get the proper results. He must do as the furnaceman does; learn the general laws applying to his materials and processes, make a study of his particular conditions, and then work out his own salvation.

THE FURNACEMAN'S PROBLEM.

Permit me, in closing, to make a plea for the furnace manager. He cannot drop his cupola bottom at 6 p. m. and feel that his tasks and troubles have ceased for a twelve hours at least. He has to run a continuous performance without a drop of the curtain or an intermission from the day he lights until he blows out, or the furnace goes out in spite of him. Don't attribute your defective castings to poor iron without having made a careful investigation, and having ascertained the facts. Remember the pig iron is but one factor in the problem. There are cokes and cokes, and coals and coals, some containing a large percentage of sulphur which is sure to deteriorate your castings. I have known foundrymen who used no flux, and whose product in consequence would acquire additional sulphur from normal and even low sulphur fuels. The manner of charging the cupola, and the position of the tuyeres have their influence. Years ago, to facilitate puddling, a preliminary process called "fining" was in vogue. It consisted in playing a sharp blast of air upon the surface of molten iron with sufficient force to agitate the metal, thus burning out a portion of the carbon and silicon. This preparation made the subsequent puddling operation shorter and easier. I can imagines tuyeres in a cupola so placed as to fine the iron, thus increasing its hardness.

The quality of castings is, also, affected by the condition of the molding sand, the manner of pouring and the form of the patterns. It is probable that defective castings are sometimes caused by the use of too much rusty or burnt scrap iron. Both kinds are iron partially oxidized, which condition is not changed by remelting except that a portion of the iron oxide may be fluxed off by silica furnished by the sand on the pig iron, dirt with the scrap, or the ash of the fuel. The cupola does not materially change the character of the iron melted; its function being merely to render it fluid so that it can be put into specific forms. The blast furnace on the contrary is the instrument used to effect a result by means of numerous and complex chemical actions and reactions. An iron ore is essentially an iron oxide with the gangue as an accident; and the function of the furnace is to deoxidize the ore, remove the gangue, impregnate the wrought iron sponge with the silicon and carbon needed to make it cast iron, and to melt the product.

It can as readily or more readily deoxidize rusty and burnt scrap, as it can the ores nature furnishes, and make therefrom fully as good pig iron.

Spelter Castings and Some Difficulties Encountered in their Manufacture.

The consumption of spelter in the production of artistic metal work runs into a considerable figure in quantity, and particularly in value, as high-grade spelter is used exclusively. Its use ought to increase in natural growth of business expansion and because of the fact that American manufacturers are making rapid progress in the art of producing really excellent work which, of course, serves to displace merchandise heretofore imported from Berlin and Paris. A broad, liberal and consistent policy on the part of the miners and refiners is without question a necessary correlative of a larger use. From spelter statuettes, clocks and clock trimmings, vases and bric-a-brac, lamps and parts of the same and many other articles can be produced. Most of the imported bronzes finished in Barbidienne and kindred colors, and popularly supposed to be "solid bronze," are made from spelter. The metal has advantages over certain others which at once commend themselves. It has a degree of strength not possessed by its nearest rivals in cost. It can be buffed and polished to a highly lustrous degree and is plated and oxidized readily in any of the popular finishes.

However, there is a curious diversity of opinion in this country among manufacturers of this class of goods as to the respective merits of spelter and its closest rival, the lead and antimony mixture. Many large manufacturers of fancy goods confine themselves wholly to the use of lead and antimony, while others in identically the same line use spelter for the same kind of work. The lead and antimony mixture has, of course, strong claims for recognition. It runs sharply, thanks to the antimony bringing out the finest details of chased and matted surfaces, but for gold-plated articles it does not afford that brilliancy and beautiful lustre which well finished spelter work exhibits. Of course, every maker of spelter goods is obliged to use other mixtures on certain classes of work, and perhaps the policy of one well-known firm in Connecticut, which uses both metals in considerable quantities, is a wise one. On the other hand, another concern, perhaps the best known in this country for the high excellence of its product in artistic metal lines, confines itself almost wholly to the use of spelter and is probably the largest individual consumer in America for the purpose mentioned.

These preliminary observations, however, merely lead up to the question, and this question is not the discussion of which is the better material, but is as to why spelter is not more generally used. I have for the past twenty years had a more or less intimate knowledge of its workings, oftentimes to my sorrow. It is a refractory metal and cannot be depended upon at all times to give the desired results. At one time a consignment of metal will work beautifully. It will run with fluidity, be free from excessive shrinkages and the surface of the castings will be soft and even, without "cold shots" or other blemishes. The next carload of precisely the same brand may be astonishingly unlike its predecessor. The castings will crack so badly at times as to fall apart when taken from the mold. The metal will flow sluggishly and the lighter parts of thin castings will refuse to unite or run together and on "slushed" work the castings are made prohibitively heavy. Again, the metal when in this condition refuses to part with its entrained gases, the result of which contingency is only too well known to the plater, who often is blamed for an unhidden green spot which at times appears on the surface just above the cavity left by the confined gas.

The reason for this lack of uniformity in quality can, in my opinion, be located. Analysis, as an index to quality, is not to be depended upon. The sales agents have refused to have their products judged by analysis, claiming that there are qualities contained in the spelter which the analyst cannot discover, and in this connection I believe they are justified. Leading authorities in iron foundry practice have adopted identical views. Taking it for granted, then, that the man of science is unable to locate the reasons for this variance in quality, it seems to me that the only recourse is to call to our aid the practical refiner or furnace manager. Years ago the writer about completed arrangements with the manager of one of the large spelter producing interests to send to their furnace an experienced spelter caster with a number of molds of various difficult kinds and shapes in order that the practical man at the furnace could compare notes with the "man behind the mold." For some reason the

manager failed to carry out this idea. Had he followed it up, I am sure his refiner would have learned much of benefit to himself, his principals and the spelter consuming interests in particular.

I have been told by a gentleman well known as a refiner of spelter, and, in fact, the originator of a leading brand, that it is possible to produce, at a good profit, pure spelter of the highest grade from almost any ore, providing the refining is done properly and under right conditions. There are low grades of spelter on the market which are far superior to the best brands in some particulars, notably for running into fine light castings, but in other qualities they are lacking, oftentimes showing faults which I believe could be eliminated, if carefully studied.

One kind I have used is absolutely preferable to the best known brands in fluidity, and, in fact, general behavior, but in passing it through an alkali bath, preparatory to plating, it becomes pitted with small holes, showing the presence of some element readily and unevenly affected by alkalies. Of course, this paragraph is written with full knowledge of the fact that spelter is dissolved in potash or soda, but the phenomenon here referred to was an unusual manifestation. I have before me two pieces of spelter broken from slabs taken from one consignment. One shows the characteristic lamellar crystalline fracture of commercial pure spelter, and is beautifully uniform in structure. The other reveals fine, close-grained crystals, indicating a fault. What causes this fault is not for the consumer to say, but the reason for it ought to be apparent at the furnace.

Spelter showing the eccentricity of fracture does not work properly, and generally cracks excessively. That the quality of the metal can be improved, the writer has no doubt. Its production is highly profitable, and there is no financial reason why the output should not be carefully selected and properly handled. Whether a larger use would justify the expense is a question for the spelter producer to decide. Another factor in comparing its value with that of other metals is the one of cost. The unit weight of the usual lead and antimony mixture is about 50 per cent greater than that of spelter, hence to be on a parity as to cost the selling price of spelter should be about 50 per cent more than that of lead and antimony. A medium grade of spelter, suitable for the cheaper kinds of castings and competing reasonably with lead and antimony in value, has been marketed, but a constant supply cannot be depended upon, so that it must be considered as a negligible factor by large consumers.

Spelter is so exceedingly refractory in behavior, variable in quality and presents so many different and puzzling freaks in handling that men of intelligence are necessary to produce the best results in the casting room. Not alone has the varying quality of the metal to be considered, but each and every mold should have especial and particular study. The degree of temperature of the molten metal must be carefully noted and made to conform to the requirements of the particular work in hand.

A point for consideration is as to how the mold should be held, and whether it should be poured at one angle or another in order to get sharp, clean castings and to permit ready escape of the pent up gas, which, if confined in the castings, leaves a hidden cavity, resulting after plating in a serious blemish, due to the working out of the cyanide through the grain of the metal. The contents of the crucible must be carefully fluxed and the dross removed, as the presence of dross in a casting is fatal to perfect work. If slushed castings are being made, the proper weight must be carefully followed, otherwise a caster can quickly waste a quantity of valuable metal. These and many other points involving intelligent discrimination require that the spelter caster be a man of ability and good judgment. Really first-class men are scarce and command good pay. Furnaces with good draft are necessary, and the metal should be melted in graphite crucibles. In our work, we use the ordinary brass-melter's crucibles, but in many shops shallow pots or coloring bowls are preferred. Spelter melts more quickly in an iron pot, but the well-known disposition of spelter to attack iron soon destroys the pot and introduces into the spelter an element which is not desirable.

The spelter refiners learned their lesson in this particular phase years ago, and why they did not warn their customers against the use of iron melting pots is something I cannot understand. Its harmful effects were certainly known to them, but for a long time the custom certainly worked as much harm to the refiner as it did to the consumer.

A phase of the spelter question which is of considerable interest is as to the employment of

alloys. We have used aluminum, but its value I consider as uncertain. At times and under certain conditions, if handled intelligently, it will certainly prove a benefit, rendering the metal more fluid and less liable to crack, but again, under seemingly identical conditions, no benefit can be noted. Pure ingot aluminum must always be used. A well-remembered episode involved the use of some aluminum scrap which had been alloyed by its makers, a fact which was overlooked until the annoying shrinkage displayed compelled a search for its cause. The proportions should be adapted to the work in hand, and but a small percentage used, as too large an addition will make trouble in the plating room.—Winslow Goodwin in *The Metal Industry*.

Among the Foundries.

The Pittsburg Foundry & Machine Works, Pitsburg, Kan., was partially destroyed by fire July 9. Loss was between $15,000 and $20,000. The machine shops, pattern and wood working departments were saved, although badly damaged. The concern was recently sold to the United Iron Works Co., a new consolidation.

The Gisholt Machine Co., Madison, Wis., manufacturer of turret lathes, has made a contract for a large new foundry which will be equipped throughout with modern, up-to-date appliances. The buildings will be strictly fireproof.

The Riverside Foundry Co., of Kalamazoo, Mich., has been organized recently by interests connected with three wind-mill companies in that city. M. J. Bigelow is president, Willis N. Pomeroy vice president, A. M. Dailey treasurer, and M. F. Richardson secretary and manager. Mr. Richardson, who was foreman of the McSherry Mfg. Co.'s foundry at Middletown, O., resigned June 15 to take up his new work. The Riverside Foundry Co. will make castings for the Kalamazoo wind-mill manufacturers, and for any capacity it may have above this will take on jobbing work.

The Mugler's Iron Works, 420 East 108th St., New York, was recently incorporated to manufacture vestibule doors, elevator cars, bank and office railings, grates, iron stairs, fire escapes and other specialties.

The Wilks Foundry Co., Toledo, O., which was organized in March, 1902, and commenced melting June, 1902, has had a prosperous career. It started with a capital of $25,000, which was increased in January, 1903, to $62,500. The original building was 200 x 65 and the addition recently erected is 200 x 106. The capacity of the two shops is 75 tons per day. Gray iron castings are made up to 40 tons. Mr. Wilks has been in the foundry business for the past 30 years. The company has a fine building for storing patterns, good fire protection, and has modern appliances for turning out work.

Plans are under way to reorganize The Economy Foundry Co., Syracuse, N. Y., which recently failed on account of heavy losses on government contracts. The plan is to form a new corporation with a capital of $200,000, half of which is to be in preferred 6 per cent stock. First mortgage sinking fund bonds to the amount of $1,000,000 are to be issued. It is proposed the creditors take the preferred stock in exchange for their claims.

The Standard Forging Co. will build a foundry plant at Indiana Harbor, Ind., at a cost of $100,000. The main building will be one story, 100 x 500 feet, and there will also be a two-story office building and a number of other structures.

The Horton Mfg. Co., Painesville, O., will soon move from its present quarters to its new plant on Richmond St. The new buildings are nearly completed. The main building is 353 x 40 feet, and has an annex of 36 x 160 feet. The main building is divided into a machine shop and foundry. The company manufactures brick machines, disintegrators, and is putting out a number of new specialties.

The Bessemer Foundry & Machine Co., Bessemer, Ala., will build an addition to its plant which will double its capacity. The cost will be about $15,000.

The Erie Railroad Co. has appropriated $100,000 for a foundry at Meadville, Pa., to be conducted in connection with its machine shop in that city.

The Pacific Iron Works, Bridgeport, Conn., whose plant was for many years owned and operated by P. H. Skidmore & Sons, will soon pass into the control of the Pacific Iron Works Corporation, a company which has been incorporated to purchase the works from the estate of Philo H. Skidmore, Jr. The new company is to have a capital of $200,000 and the incorporators are to be Henry A. Bishop, H. D. Beach and William B. Boardman.

The plant of the Cureton Foundry Co., Mt. Vernon, O., recently became the property of H. N. Hills and U. S. Lybarger, proprietors of the Gambier Savings Bank and the Dime Savings Bank, of Mt. Vernon. The property is admirably situated, on a spur of the C. A. & C. Railroad, with a switch to the B. & O. Railroad. It has a capacity of 25 tons a day and is able to make fine castings weighing as much as 20 tons each. The owners have secured as manager George W. Lee Vey, for several years superintendent and manager of the Blymyer Iron Works, of Cincinnati. He is a man of Eastern birth and training, having been reared in Hartford, Conn., but he has spent the last twenty years in the middle West. The company has been having a large increase in orders and is preparing to extend the foundry and enlarge its capacity.

Altering Old Patterns Not Always Profitable.

In a shop doing a large and varied line of work, most of it of a character which may never be called for a second time, the temptation to adapt old patterns to new uses is a very great one, and it requires a great deal of judgment and some philosophy to yield to it only at the proper times, and to firmly resist it at all others. Sometimes it pays to alter an old pattern for a new job; but, on the other hand, this is often done under circumstances that render it one of the worst varieties of false economy. The pattern is always more or less injured, and labor must always be expended in restoring it to its original shape in case it is required to duplicate the casting for which it was made. Except with a very excellent system of pattern keeping and storage, much time is often lost looking for patterns which have been so built up and altered for other uses as to be utterly unrecognizable. I have repeatedly seen men lay aside the very thing they were in search of because it had been so changed as to bear no resemblance to its original form. This means an expense in the pattern shop which should be set off against the cost of making a new pattern, and it is often coupled with extra cost in the drawing-room due to the endeavor to design other parts so as to render the old pattern available without too much changing. Again, the pattern used is often required to be built up on one part and stopped off on another. This means a larger flask than would have been necessary with a proper pattern and more time spent in ramming up superfluous sand, filling up and patching the mold, to say nothing of the time the molder spends scratching his head and trying to assure himself that he understands the thing aright, or that spent in conference with the patternmaker in obtaining a further explanation of the meaning of some of the stop-off marks. Where forming pieces are furnished by the patternmaker to be held in the mold while filling up the stopped-off portions, directions for their use are very often required, and this takes the time of both the patternmaker and the molder. As a means of avoiding some of these difficulties the method of stopping off by means of cores is resorted to. When this is done core prints must be added to the pattern, core boxes must be made, and this, with the coremaker's time and the cost of his materials, very much reduces the advantage gained by using the old pattern. Following the work into the machine shop, in many cases the pattern cannot be made exactly right, and we must depend upon the machinist finishing the casting to size. The core-box for a cylinder is a trifle too small, but the machinist can, of course, bore the casting out all right, is we only give him time enough. The same is true of the pattern for the plunger; if it be somewhat too large there is nothing to prevent the casting being turned down, except the cost of doing it. In this connection, however, it is not wise to lose sight of the fact that the machinist operating a large tool, using cutters are furnished and ground at the expense of the establishment, represents a daily cost several times that of the patternmaker working at a cheap wooden bench and wearing out tools which he pays for himself, for the most part. Sometimes the original job required finish which might be entirely dispensed with in the case for which the old pattern is next used, but the finish has been allowed on the pattern and must be removed from the casting if the latter is required to be brought to size. When contemplating such a proceeding as this, moreover, it is well to remember that steel castings cost more to machine than do iron ones. This consideration will often determine that it is cheaper to make the pattern to size rather than to reduce the casting in the machine shop. In dealing with an expensive metal, such as phosphor bronze, the difference between what is paid for new casting and what

is received for chips must also be taken into account.

In what has been said above, no notice has been taken of what is sometimes a most important consideration, and this is that the cost of the pattern occurs only once, while all of the other costs attach to every piece which may be made from it. A case which comes under my own observation is that of a cylinder pattern somewhat too large for the purpose for which it was used. A new stuffingbox head was made for it to suit the size of plunger required, and the large dimensions of the cylinder did no harm except that it cost more for metal, more for molding, more for machine work, more for bolts to bolt the head on, more even for painting it. As this pattern has been used repeatedly, these added costs would have paid for a new one several times over.

It is well to save the price of a pattern when it can be done so readily, but to save fifty dollars in the pattern shop at a cost of $100 elsewhere is poor policy. When in control of the designing, it is well to keep within the lines of standard patterns as much as can be done conveniently, but it seldom pays to take a pattern which is in active service and devote it to another purpose. If the pattern is likely to be called for in its original shape, it will generally pay better to make a new one rather than to build up, or, still worse, cut down the old one.

In the case of patterns which are to be used very frequently, the cost of keeping them must be given its share of consideration, and it sometimes proves advisable to make a full set for a given tool and keep them together, even though some of them are duplicates of existing patterns which are used for other purposes. There is then no excuse for delay in starting work upon such a job. As soon as the order is received, the patterns are ready to be put in the sand, and the time which would otherwise be spent in assembling them may be devoted to something else. In many establishments the time which is spent in looking for things is a large factor on the cost side of their accounts, and the efforts to stop this leak may prove to be as well directed as others which at first seem of more importance. —Gerald E. Flanagan, in *American Mechanic.*

Hiram Freidenwald will build a foundry, two stories, 63x137 feet, in Baltimore, Md.

Notes from Various Sources.

The American Car & Foundry Co. made a contract with the Big Four Railroad by which it will build 800 coal cars, 200 hopper cars, and 100 coke cars at a total cost of $810,220.

The McClary Co.'s new foundry at the foot of Adelaide street, Toronto, began operations July 1. The molding room, which is a substantial brick building, is 200 x 220 feet. The building in which steel ranges will be manufactured is 307 x 82 feet, and built of concrete.

William H. Landrum, whose foundry at Rolling Hill, Charlotte county, was recently destroyed by fire, has decided to locate his new plant at Keysville, Va. The new concern will be known as the Keysville Plow Works.

The foundry of the Slater Engine Co., Warren, Mass., has been shut down and will not resume until the company has reorganized. Work in the machine shop will keep 30 men employed about two weeks. Plans for re-organization are now on foot, and President Frank Slater announces that the works will resume as soon as terms with the creditors can be agreed upon.

The Canada Foundry Co., Toronto, is importing from Europe molders, pattern makers and machinists to take the place of strikers who quit work a few weeks ago. The company has a large number of orders on hand and expects to be soon in working operation.

Harry Guenther & Bro., proprietors of the Novelty Foundry & Machine Works, Owensboro, Ky., expect to erect a new building shortly and will require a number of new tools, just how many and what sizes they have not decided.

The Fillmore Avenue Foundry & Iron Works, Inc., Buffalo, N. Y., has just completed an extensive addition to its foundry, enabling it to very materially increase its output of light machinery work.

The Crucible Steel Casting Co., Milwaukee, Wis., has decided to build a foundry at a cost of $9,470.

The Topeka Railway Co., Topeka, Kan., will build a machine shop at a cost of $35,000.

Alterations costing $7,000 are to be made in the foundry building of the Enterprise Mfg. Co., Bodin street, Philadelphia, Pa.

The Stowell Mfg. & Foundry Co., Milwaukee, has purchased four acres of land in the town of Oak Creek, which adjoins the pres-

ent site of the company's plant. The company will ultimately begin additions to its plant. At present only an office building will be erected.

The Pattin Bros. Co., Marietta, O., contemplates making additions to its foundry and machine shops. Additional land has been purchased.

Work on the new MaGirl foundry, Bloomington, Ill., will be completed in a month or two. The machinery in the present building will not be moved to the new structure before December 1.

The Toledo Foundry & Machine Co. will erect another large foundry building and machine shop at Toledo for the manufacture of dredges, pile drivers, excavators, and to do all kinds of marine and railway work. The new buildings will cost about $60,000. The foundry company at present occupies a three-story brick structure, and the land recently purchased has an entire half square, the aggregate frontage being 182 feet on Cherry street, 148 feet on Water street, and 180 feet on Vine street. The company has decided to do the erecting work itself. The officers are: President, H. W. Koekler; general manager and treasurer, J. C. Wuerfel; secretary, C. E. Wuerfel.

The S. Obermayer Co., of Cincinnati and Chicago, manufacturers of foundry facings and equipments, have secured the contracts for the foundry equipment of the new technical school of the University of Chicago and for the "Crane" School, of Chicago. In these contracts are included complete outfits for both brass and iron foundries.

The Burlington Foundry Co., Burlington, Kan., has succeeded to the business of G. W. Reams & Sons. The company will enlarge the plant and install new machinery.

The American Car & Foundry Co.'s branch office at Terre Haute, Ind., has secured the contract for supplying the Chicago & Eastern Illinois Railroad shops at Danville, Ill., with castings for one year.

The El Paso Foundry & Machine Co., El Paso, Tex., will move its plant to a larger site, and will occupy about ten acres.

The Shunk Plow Co., Bucyrus, O., manufacturers of steel plows and steel wagons, will erect a foundry, 60x200 feet.

The new foundry of the Whittier Machine Co., South Boston, Mass., will be of brick and steel, 76x220 feet, one story.

Harmance & Marsh, Williamsport, Pa., are erecting a new foundry adjoining their present plant. It will be 38x80 feet, two stories.

The July meeting of the New England Foundrymen's Association was in the form of an outing, the members dining together informally at Winthrop, Mass., July 8th.

The Cresson Foundry, Machine & Car Co., recently incorporated, has been organized at Cresson, Pa., by the election of the following officers: President, John W. Kephart, of Ebensburg; vice president, P. B. Cosgrove, of Hastings; secretary and treasurer, R. Edgar Leahey, of Ebensburg.

The Raleigh Foundry & Machine Mfg. Co., Raleigh, N. C., has been incorporated with a capital of $75,000.

The Raughley Foundry & Machine Co., Thermal City, N. C., has been incorporated with a capital of $75,000.

The United Iron Works, Oakland, Cal., has been incorporated with a capital of $500,000, of which $500 has been paid in, to do a general foundry business.

Greenlee Bros., Rockford, Ill., will build a foundry, 169x500 feet, which will be completed before winter.

The Smalley Motor Co., Ltd., Bay City, Mich., has completed its plant which includes a foundry, 50x125 feet. The output is exclusively marine gasoline engines and attached parts.

The new plant of the Herron-Brady Pump & Foundry Co., Chattanooga, Tenn., is now in operation.

The Wausau Foundry & Machine Shops, Wausau, Wis., recently incorporated, have installed new machinery, and will put in further equipment.

The Sterling Foundry Co., Sterling, Ill., is a prosperous concern, doing a jobbing business in gray iron castings. It is putting a number of specialties on the market.

The net earnings of the American Car & Foundry Co. for year ended April 30th were $7,059,900, an increase of $2,764,300, or nearly 65 per cent over the net earnings of the preceding year.

The Wing-Sale Foundry & Machine Co., Little Rock, Ark., has been placed in the hands of a receiver. Assets of the company are about $10,000 and liabilities about the same.

The Dayton Foundry Co., formerly a partnership, at Dayton, O., has been incorporated under the laws of New Jersey with a capital of $75,000.

The Emmert Mfg. Co., Waynesboro, Pa., is now completing a two-story storage building and office, 63x38 feet; also a machine ship, 45 x125 feet, one story, and will begin work on a new foundry in the near future.

The Standard Foundry Co., Buffalo, N. Y., has been incorporated with a capital of $10,000.

The new foundry of the Mansfield Engineering Co., Mansfield, O., is now in operation. The new pattern room will soon be completed.

Contracts have been awarded for a large addition to be constructed at the Detroit plant of the American Car & Foundry Co.

The Bedford Bros. & Hitchens Foundry Co. has changed its place of business from Dubuque to Waterloo, Ia., and has increased its capital stock from $5,000 to $25,000.

The plant of the McKeesport Foundry & Machine Co., located on part of the ground recently sold to the National Tube Co., has been dismantled and the machinery moved to the new plant on First avenue. The company began business fourteen years ago.

Owners of foundries in New York and vicinity have organized the New York and New Jersey Foundrymen's Association. H. Van Atta was elected president.

The new addition to the Colton foundry, Galesburg, Ill., is now nearly completed. About sixty men are employed.

The Buffalo Foundry Co., Buffalo, N. Y., has increased its capital stock to $500,000, and the plant is to be enlarged in every department.

Personal.

Patrick Kennedy, the well-known Baltimore, Md., foundryman sailed from New York, July 8, for a three months' tour of Great Britain and the continent. A committee of employes filled Mr. Kennedy's office with flowers on the day before he left Baltimore and several hundred employes and others called at the office to bid him bon voyage. A gold watch was given Mr. Kennedy by his men and in an address on their behalf he was told that he was the best employer in the country.

G. H. Carver, formerly connected with the F. C. Austin Mfg. Co., Harvey, Ill., and at one time president of the Western Foundrymens' Association, is now general manager of the National Drill & Mfg. Co., at Barberton, O.

Paul R. Ramp, heretofore of the Mahwah, N. J., plant of the American Brake Shoe & Foundry Co., has become assistant general superintendent of the Corning, N. Y., plant of the same company.

The Portsmouth Steel Co., Portsmouth, O., has accepted the resignation of Henry Thomas as superintendent of its plant and elected Floyd Knowles as his successor. Mr. Knowles has been superintendent of the foundry department for some time.

Geo. H. Gibson has resigned as manager of the advertising and publication department of the B. F. Sturtevant Co., of Boston, Mass., to accept an appointment with the International Steam Pump Co., having offices at 114-118 Liberty St., New York City. Mr. Gibson was formerly connected with the Westinghouse Company's publishing department, of Pittsburg, and was for two years a member of the editorial staff of the *Engineering News*.

Deaths.

William Garrett, the well-known rolling mill engineer, died at Mt. Clemens, Mich., July 15, aged 59 years.

Albert Manchester, superintendent of the Portsmouth Foundry & Machine Works, Portsmouth, O., died suddenly in New York, July 7, aged 45 years.

Robert Marshall, a well-known foundryman and elevator builder of Pittsburg, died June 22, aged 67 years.

John Wesley Hardwick, president of the Erie Mfg. & Supply Co., and general manager of the Union Iron Works, Erie, Pa., died July 12, aged 36 years.

Fires.

Fire at the plant of the Cuyahoga Stove Foundry Co., Cleveland, July 12, caused a loss of $7,000.

The Hornellsville Foundry Co.'s plant at Hornellsville, N. Y., was destroyed by fire July 8. It will be rebuilt.

Lightning struck the Gem City Stove Foundry, Quincy, Ill., June 25, causing considerable damage. Work in the foundry was not interrupted.

The foundry of the Duplex Mfg. Co., recently completed at Elyria, O., was destroyed by fire June 27. The loss amounted to $6,000 fully covered by insurance.

Fire originating with the coke ovens caused a loss of $5,000 at the Youngstown (O.) Steel Casting Co.'s plant July 20.

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